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Just Getting Along

JAMES H. McGRAW concluded a recent inspiring address to the editors of the McGraw-Hill papers with the epigrammatic remark, "It does not interest me just to get along."

The occasion was not an arraignment of the staff, but a joint discussion of plans for the coming year by those in charge of the editorial policies and activities of papers dealing with all the branches of the engineering profession and industries.

And the Chief, enthused and exalted with the opportunities for greater and better service as he saw them develop, invoked higher ideals and bespoke new effort for their attainment.

The conditions of modern life are conducive to mediocrity. In many lines the worker performs the same sort of an operation, mental or manual, repeatedly, hour after hour, day after day, until it becomes mechanical.

If he does not make too many mistakes adding up columns of figures or spoil too many pieces in his automatic machine, he holds his job and "gets along."

And his side kick, who takes an intelligent interest in the job and turns out more and better work than he does, gets along, too.

And at the same pace.

Why should he worry? The better he makes things the longer they last and the less competition there is for his labor.

The more he makes of them the less there are for others to make. Why work some other fellow out of a job?

Why should he think? He can get his opinions ready made in newspapers, magazines and over the radio. And his impulses toward the esthetic, the romantic, the heroic are lushed to death by the tabloid sheet and the cheap movie.

But some day the foreman looks for a man for a particular job. Some day the manager looks for a foreman or the president for a manager.

It is not the man who, in the stage below, has been "just getting along," who will be selected.

F. R. Low

A.S.M.E. Week In New York

The Forty-Eighth Annual Meeting—A Session of Intense Technical Discussion and Renewal of Cordial Personal Relationships—Alex Dow Inaugurated to the Presidency

RECORD-BREAKING attendance contributed its share of enthusiasm to the 1927 Annual Meeting of the American Society of Mechanical Engineers. At noon on Thursday the registration was already some two hundred above the last year's final total. The program covered a wide range of engineering interests, but for the *Power* reader the most significant subjects were those relating to what may be classed in general as thermal and power problems.

It is evident from the interest displayed at several sessions that the problems uppermost in the minds of power engineers still center in the boiler room. Preparation and combustion of fuel, and the effective absorption of heat by water, steam and air heating surface entail an intricacy of technical complications that is commanding the attention of the best engineering talent of the country. Leaders from all parts of the country attended the sessions and participated actively in the vigorous discussion of the papers presented.

Indicating the range of Society activities was the schedule of no less than 41 meetings of committees and less formal groups to discuss the technical work being carried on under the auspices of the Society. The catholicity of interests covered by these meetings is striking evidence of the widening field of the mechanical engineer in the present-day social order. Hundreds of members were involved in these sessions, and through their untiring activities the standards of service of the profession are steadily rising to higher and higher levels.

The social functions of the meeting followed the customary schedule and were of a high standard. The "Open House" party of Monday evening was staged by the Philadelphia Section. This participation of a local section in the conduct of the Annual Meeting was an innovation that proved highly successful. The party was well attended, and proved exceptionally pleasant for everybody. The hard work done by the Philadelphia Committee was amply rewarded by the unanimous gratitude of all who were fortunate enough to be present.

> "You have been set apart for service, not in a temple but in the broad and practical field of material things—a field of romance and adventure, of discovery and conquest, where the frontier ever recedes and never ends; where victories spell the defeat of no foeman, and gains are no competitor's loss. What is created is added to the world's wealth, and what is discovered is added to the world's knowledge."—*From the charge to new members by past-president William L. Abbott.*

The presidential reception on Tuesday evening followed the convocation at which retiring President Schwab delivered his masterly address that appears on a later page.

Alex Dow, the incoming President, was introduced to the members, and spoke in his characteristically human and humorous vein, expressing the hope that all the members would speedily consider him as an elder brother whose desire is to be of assistance to each one of them.

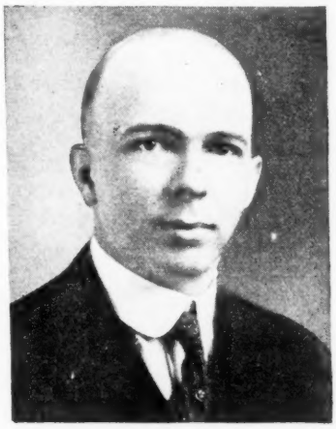
The annual dinner, served at the Hotel Astor on Wednesday evening, was a brilliant occasion. With well toward 1,000 members and ladies in attendance and with a splendid program of addresses, followed by dancing until 2 a.m., the evening was both profitably instructive and delightfully entertaining. In a graceful valedictory address, Mr. Schwab paid his respects to the friends he has made during his administration. Following this was the annual ceremony of greeting to the Society such new members as could be present, with a charge delivered to them by junior past-president Abbott.

President Dow spoke briefly, closing with a statement of his philosophy of life, which he summarized as "So to order my ways that in my comings and goings there shall be if possible an increase in the sum total of human happiness, and in no case a decrease."

The principal address of the evening was a description of the accomplishments of the chemist in the realm of new materials of construction, by Dr. Harrison E. Howe, Editor of *Industrial and Engineering Chemistry*. He showed a dazzling array of samples of the materials he referred to, including numerous cellulose products, "dry ice," and a number of other recent developments that promise to mean much in the industrial development of the world.

Simultaneous with the A.S.M.E. meetings there were held the annual meetings of the American Society of Refrigerating Engineers, of the Power Transmission Association, of the Taylor Society and a conference of the American Engineering Standards Committee.

Newly Elected Officers of the A.S.M.E. 1927-1928



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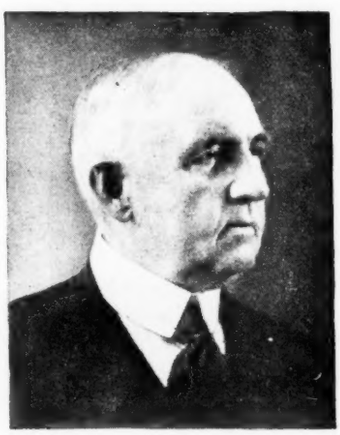
Vice-President

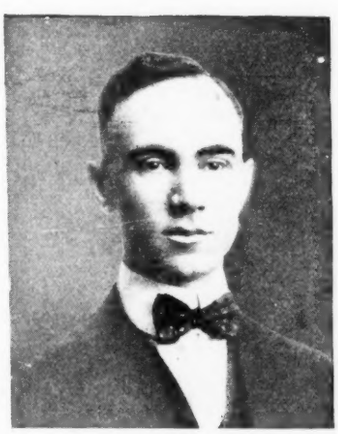
ALEX DOW
President

J. H. LAWRENCE
Vice-President



NEWELL SANDERS
Vice-President

E. A. MULLER
Vice-President



W. A. HANLEY
Manager

J. B. MCMILLAN
Manager

F. H. DORNER
Manager

Human Engineering

By CHARLES M. SCHWAB

Presidential Address to A.S.M.E.

UPON "human engineering," or "industrial statesmanship," based upon the fundamental principle of equitable relations between employers and workers, recognizing the spirit of loyal co-operation and the reasonable rights of employees, will depend the future welfare of the nation, was the message of Charles M. Schwab, delivering his presidential address the evening of Dec. 6, which opened the 48th annual meeting.

The management of men on a human basis is increasingly necessary for successful large-scale production, more important than even the development of new machinery, declared Mr. Schwab. "One cannot reflect on the subject of human engineering without realizing the tremendous responsibility that rests upon management in guiding the destiny of mankind. Indeed we are impressed that the solution of this problem holds out a challenge to industrial statesmanship that is of paramount importance to the prosperity of our nation. It is a tribute to American industrial management that these principles have largely been recognized and that in this country today the parties to industry generally recognize their responsibilities and opportunities.

Charles M. Schwab

"What are the reasonable wants of employees, which they have a right to see satisfied as far as conditions of industry permit? I believe they include the payment of fair wages for efficient services; steady, uninterrupted employment; safeguarding of their lives and health; good physical working conditions; provision for them to lay up savings and to become partners in the business through stock ownership; and finally, some guarantee of financial independence in old age.

"The desire of labor in connection with wages can, I believe, best be fulfilled by rewarding men in accordance with their contributions toward the success of the business. It is fundamental with human beings that they want individual recognition of and reward for their talents and achievements. This is the crux of the wage problem. The nearer we can come to fulfilling this want on a sound, justifiable basis that recognizes individual merit, the sooner shall we witness the solving of a long-standing and contentious question.

"Our better relationships have brought a clearer understanding of the reciprocal value to national well-being of a class of well-paid workers whose buying power is sufficient to take the output of our mass production. We are ambitious to see our workers receive a wage that is sufficient to afford a worker and his family a decent standard of living with a margin for laying something aside—but we cannot entertain any uneconomic theories as to doles or subsidies. We cannot lose sight of the law that requires full value in services for wages paid.

"The earnings of American wage earners in terms of what they can buy are probably greater now than at any previous period in American history. In the face of these higher earnings our foreign brothers marvel at the coincidence of lower costs. The answer is that American workmen have come to realize that wages and profits are paid out of the same pocketbook and that the return to each must be proportionate to effort expended.

"High wages do no good to the man who has no chance to earn them," Mr. Schwab continued. "Hourly and daily rates mean little to the employee who can work only a few days a month or a few months out of the year. Steady employment, therefore, ranks high among the needs of the workman. During the last few years industrial managers have been giving much thought to this question—to the elimination of the evil of unemployment. It has come to be realized that peaks and valleys of industrial activity, during which periods of feverish effort to get out products alternate with periods of idleness and stagnation, not only are undesirable from the standpoint of the workingman, but are wasteful and expensive to industry and to society as a whole. Toward the leveling of these peaks and valleys much has been done by the intelligent efforts of management; perhaps even more has been accomplished as a result of the sustained purchasing power built upon high wages and of the changed buying methods of the public.

"But even with good wages and steady employment, the workingman is likely to lack one factor essential to his fullest efficiency and greatest interest in the company by which he is employed. This factor is ownership. A sense of proprietorship affords a powerful incentive to arouse interest in the performance of work. This principle has been the motivating influence of those who have been willing to take the risk incident to the building of all business. Recent years have seen a considerable growth in stock ownership by industrial

employees. I would not minimize the possibilities of danger involved in this practice, nor would I urge every company, regardless of the character of its securities, to enlist its wage earners as partners. Under favorable circumstances, however, and with the proper safeguards against speculation and possible loss, stock ownership by employees may be one of the most successful incentives to thrift and at the same time to vital interest in the enterprise.

"The opportunities for further service in industrial statesmanship and engineering are indeed immeasurable. We have not attained perfection, but we have made real progress and reaped substantial rewards. This knowledge should hearten us to strengthen, perpetuate and extend the principles of this new order of human relations, so gloriously started, that we may have a nation of contented, self-respecting workers and citizens, and a sound, prosperous, progressive industry in the interests of society at large.

"In my belief that we shall continue to meet this challenge lies my abiding faith in the future of American industry."

Melville Medal Presented to L. P. Alford

PRESENTATION of the Melville Medal, awarded annually for the best paper offered to the A.S.M.E. during the year, was made to Leon P. Alford by President Charles M. Schwab following the presidential address the evening of Dec. 7. Fred R. Low, editor of *Power*, introduced the recipient.

Mr. Alford's paper, accounted the most outstanding contribution of 1927, was on "The Laws of Management." The author was active with Herbert Hoover, Secretary of Commerce, in organizing the American Engineering Council and served as vice-president of the Society 1920-22. He is vice-president of the Ronald Press Company and editor of *Management & Manufacturing*.

The Melville Medal was instituted and endowed by Rear Admiral George Melville, honorary member and past-president of the Society to be presented yearly for an original thesis of exceptional merit contributed to the Society for discussion and publication.

Industrial Power Session

FOLLOWING the custom initiated two years ago by a few members of the Power Division who were concerned with industrial power plant problems, a luncheon held Tuesday noon was attended by forty-four power executives representing numerous industries. Plans were formulated for counselling with the Professional Divisions in the selection of papers and authors on questions relating to the generation and application of power in industrial plants and for the presentation of an annual progress report covering various branches of the field and an investigation of appropriate methods of cost accounting in the industrial power plant department. Under a new arrangement, the composition of the five-man Executive Committee of the Power Division is to alternate, year by year, between 3 to 2 and 2 to 3 central station and industrial power plant men, respectively.

Two papers were read at the Industrial Power Session on Tuesday morning—"The Ruths Steam Accumulator," by R. A. Langworthy and "Stresses and Reactions in Expansion Pipe Bends" by A. M. Wahl. Abstracts of these follow:

The Ruths Steam Accumulator

CUTTING production costs through the use of the Ruths steam accumulator was the theme of a paper by R. A. Langworthy, vice-president and general manager, Ruths Accumulator Company, Inc. The steam accumulator, he said, is an unique piece of power-plant equipment, capable of producing results that cannot be produced by any other equipment or combination. The accumulator steadies the load on boilers and the supply of steam to process heating apparatus.

The accumulator is based on the principle of storing heat in a large quantity of water under pressure and releasing this energy in the formation of steam under decreasing pressure. The principle is old. The capacity of an accumulator in pounds of steam that may be produced for a given pressure drop per cubic foot of water varies with the allowable pressure drop and with the initial pressure. For higher initial pressure and for smaller pressure drop the capacity is smaller.

Steam storage capacity in an accumulator can be obtained much more cheaply than in a boiler. Boilers should be built only for the purpose of generating steam at a constant rate, and all necessary water space should be arranged for in a separate receptacle built for a lower pressure, in which wider pressure fluctuations may be allowed than in the boiler.

Steam accumulators have been built in sizes from 200 to 13,000 cu.ft. volume, and in one mill an accumulator installation of a total volume of 37,000 cu.ft., with a capacity of 150,000 lb. of steam, has been erected. This accumulator is divided into three separate tanks.

Automatic control is of the highest importance in the proper functioning of the accumulator system. The accumulator must be connected between a high-pressure and a low-pressure steam line. The pressure in both steam headers is kept constant, and only the accumulator pressure is allowed to vary. Typical installation layouts were shown, and the operation of the valve control was described in detail. The author's company has developed a sensitive, positive and reliable pressure control valve of the double balanced-disk type, operated by oil under pressure through the medium of a pilot valve and relay controlled by the pressure to be regulated.

An important recent development in industrial power-plant design has been the tendency to adopt higher steam pressures. By generating steam at 400 lb. to 500 lb. pressure, and using non-condensing or bleeder turbines to supply steam at the pressures needed for process work, a large amount of byproduct electrical power can in many cases be obtained at low cost. Since the demand for

process steam and the demand for electric power seldom coincide, the power that could be generated is often curtailed to prevent waste of steam to atmosphere. In installations of this type the steam accumulator finds an excellent application. By storing the excess steam at times of low steam demand, to be used later, it makes possible the generation of the maximum byproduct power without wasting steam.

One of the most important functions of the accumulator, and the one most difficult definitely to appraise, is its beneficial effect on the quantity and quality of production. Constant steam pressure and temperature are necessary for uninterrupted production and uniform quality in the goods produced.

Boiler efficiency during actual operation has been increased in plants equipped with accumulators. With an accumulator the boilers may operate continuously under the most favorable conditions, and their operation is independent of that of the manufacturing plant and the power plant. Savings in fuel of from 10 to 15 per cent, and even more, have been made. Forcing of the boilers is avoided. This reduces to a minimum the upkeep cost for boilers, furnaces and firing equipment. The operation of the boiler house and power plant is simplified, with a labor cost saving. Both capital and operating costs of a new steam power plant are considerably reduced when the steam accumulator is adopted. When the accumulator is installed in an existing plant, the savings pay for the installation in a short time. It is frequently possible to reduce the number of boilers in service when an accumulator is installed.

The author describes in detail a number of actual installations of accumulators in industrial plants of various types, including a sugar refinery (see *Power* for Nov. 29, 1927, page 808), a textile mill, and a pulp and paper mill.

The author's purpose will have been accomplished if the paper assists in bringing about a better understanding of the steam accumulator and its economic importance to industry. It is more than a piece of power-plant equipment. It is an economic influence whose application assists the manufacturer in reducing costs and improving production.

Discussion

In discussing Mr. Langworthy's paper, A. A. Bato described the accumulator installation at the Harrison Gas Plant of the Public Service Electric and Gas Company, in which the accumulators are furnished with excess steam from the auxiliaries and waste-heat boilers and in turn give up steam to supply the gas generators. He was of the opinion that in many cases, such as dyehouses, etc., hot-water storage tanks are preferable, because of the smaller volume and lesser cost involved. In other cases he believed the use of both hot-water storage tanks and steam accumulators present the most economical solution.

R. S. Bayntun, while conceding that each case presents its particular problem, was of the opinion that, in general, for pulp and paper mills employing pressures of 300 to 400 lb. the high-back-pressure turbine is better than the accumulator. To this the author replied that in such mills the digester load is adapted especially to the use of an accumulator.

In this connection R. D. Blanchard believed that while steam bled from the turbine is all right for the digesters, it is difficult to procure a turbine with proper regulation to supply just the required amounts for the paper machines. Here an accumulator may prove more economical.

W. A. Shoudy pointed out that increased production often accompanies the establishment of constant pressure in the process steam supply. This results in a greatly increased demand for steam. Hence the installation of on accumulator may actually increase the coal bill, but in this the increased production should not be lost sight of. With reference to the effect of load on plant efficiency, Mr. Shoudy was of the opinion that there may be a difference of 5 to 8 per cent between a constant load as established by test conditions and what may be termed a commercially constant load. In this the operating force is a factor.

In closing, Mr. Langworthy stated that customers usually want about 25 per cent return on the investment. Where properly applied, an accumulator will usually show a saving of 10 to 11 per cent. Moreover, accumulators make the operator's work easier due to more constant pressure, and here is another indirect saving. The accumulator is best adapted to handling peaks of from one-half to one hour in duration.

Stresses and Reactions in Expansion Pipe Bends

BECAUSE of the present-day trend toward higher steam pressures and temperatures, with corresponding increase in the expansions to be provided for in pipe lines, the problem of taking up these expansions becomes increasingly important. On account of their efficiency expansion pipe bends have, in recent years, come into wide use for this duty. These bends must, however, be so designed that the reactions exerted by them on adjacent structures will be kept down to safe limits, while at the same time stresses occurring in the bends themselves will not be excessive.

However, the usual theory of bending of curved bars, such as is ordinarily employed in the design of pipe bends, can be shown in many cases to give erroneous results, due to the fact that the cross-section of the pipe becomes distorted or flattened. A small amount of flattening reduces the stresses in the outermost fiber. A like condition also exists along the concave side of the bend, where flattening decreases the compression stress in the innermost fiber.

The effect of the outermost fibers relieving themselves of stresses because of the flattening, is the same as if the moment of inertia of the cross-section were reduced, and the actual deflections are greater than calculated by the usual formulas.

A. M. Wahl, Research Laboratory, Westinghouse Electric & Manufacturing Company, in his paper, "Stresses and Reactions in Expansion Pipe Bends," has developed equations that take into account the flattening or distortion of the cross-section of the pipe The equations developed cover twelve different cases of typical expansion pipe bends.

In order to check the derivation of these equations, tests were conducted on 1-in. and 2-in. diameter steel tubes and on a 1-in. diameter brass tube. All bends were U-shaped and with a radius of about six inches. The method of loading and of measuring deflections is shown and described. The results of the test are given in load

deflection curves, and a comparison is made between the test results and the results computed by using the new formula and the ordinary formula for computing pipe bends.

In addition to these test checks the author has recalculated the data on tests made by Crocker and Sanford on 4-, 6- and 10-in. diameter pipes, and presented his calculation in comparison with the data and calculation of Crocker and Sanford. The deflections calculated by the author's formula are in the main in better agreement with the observed deflection than the results obtained by the Crocker and Sanford formula.

The six appendices to the paper deal with the application of Castigliano Theorem, formulas for turbine expansion bends, derivation of formula for transverse stresses and for the amount of flattening, derivations of formula for maximum equivalent stresses in pipes and the effect of steam pressure on amount of flattening.

In discussing Mr. Wahl's paper, Sabin Crocker, of the Detroit Edison Company, agreed with the author as to changes in cross-section of the pipe in a U-bend in contradiction to the theory advanced as a result of German investigations that minute wrinkles are produced on the pipe surface at the inside of the curve. The flattening in cross-section, Mr. Crocker explained, is due to flexure and not to pressure in fabrication. In an expansion U-bend, made up of elbows and sections of straight pipe, there is no such flattening. He told of the studies made by his company with models but cautioned that, wherever possible, measurements with full-sized pipe are desirable as certain factors enter the problem that may not be evident in the small-sized pipe used in strictly experimental studies.

Sterling S. Sanford, also of the Detroit Edison Company, in a written discussion explained that the forces exerted in such bends are directly proportional to the moment of inertia of the pipe cross-section and inversely proportional to the cube of the linear dimensions. The restraining moments at the anchorages are inversely proportional to the square of the linear dimensions. Moreover, the forces and restraining moments are directly proportional to the deflection or expansion. Mr. Sanford plans by test shortly, to determine the relation between models and the actual pipe.

Central Station Session

THIS session, in attendance, was one of the largest of the meeting. Upon invitation from Chairman Ricketts, President Schwab fittingly addressed a few remarks to the work of the Power Division.

Following a report on "Progress in Steam Power Engineering" by John A. Hunter, the three scheduled papers were read.

Metals at Elevated Temperatures

A PAPER by Prof. A. E. White and C. L. Clark, on "Properties of Ferrous Metals at Elevated Temperatures as Determined by Short-Time Tensile and Expansion Tests," considered both plain and alloy steels. The original investigators covered short-time tensile and expansion tests on 0.13 per cent and 0.38 per cent carbon-steel tubing and Enduro tubing (an alloy containing 16 to 17 per cent chromium and about 0.10 per cent carbon). Similar tests on 0.37 per cent carbon steel standard 0.505-in. diameter test pieces were in general agreement with those on the tubing.

It was found that the tensile strength and proportional limit of the steels decreased steadily with increasing temperatures. With one exception the Enduro metal showed superior proportional limit values, although its tensile strength was practically the same as the 0.38 per cent carbon steel at most of the temperatures involved.

Expansion tests on 0.13 per cent carbon-steel tubing indicate that at 1,500 deg. F. (816 deg. C.) and 1,250 deg. F. (677 deg. C.) the creep value is considerably under the proportional-limit value, while at 1,100 deg. F. (593 deg. C.) the proportional-limit value agrees approximately with the load below which rupture cannot be obtained within a reasonable period of time. Tests in sufficient number have not as yet been conducted at 1,000 deg. F. (538 deg. C.) to determine any relationship between proportional-limit values and expansion findings.

Expansion tests on 0.38 per cent carbon-steel show that the creep value is considerably under the proportional-limit value as determined by short-time tensile tests. At 1,250 deg. F. (677 deg. C.) it is only about one-third of the proportional-limit value. The loads used in the expansion tests at 1,100 deg. F. (593 deg. C.) were too high to allow the drawing of any conclusions regarding the relationship between expansion-test values and short-time proportional limit values. At 1,000 deg. F. (538 deg. C.) it appears as if the critical expansion value and the short-time proportional-limit value were nearly the same.

Expansion tests on Enduro tubing show a rather close agreement between expansion findings and short-time proportional-limit values. At 1,500 deg. F. (816 deg. C.), the stress below which failure is not to be expected within the economic life of the metal is only about 200 lb. below the short-time proportional-limit value. At 1,250 deg. F. (677 deg. C.) the critical stress is only 800 lb. below the short-time proportional limit, while at 1,100 deg. F. (593 deg. C.) failure has not been obtained with loads in excess of the short-time proportional limit values.

In the latter part of the paper composite proportional-limit values are given for five classes of steels: Plain carbon, chromium, manganese, nickel, and miscellaneous. The outstanding steels in each of the groups are then compared with one another. As a result, it appears that the steels possessing the best properties at elevated temperatures, as determined by proportional limits, are the 20 per cent chromium, the 1.55 per cent manganese, the 4.96 per cent cobalt and the chromium-vanadium. Of these the 20 per cent chromium appears to have decided advantages at temperatures above 1,000 deg. F. (538 deg. C.), and the 1.55 per cent manganese, because of its good qualities and relative cheapness, appears to possess de-

cided advantages at temperatures of 1,000 deg. F. (538 deg. C.) and under.

Discussion

In discussing Professor White's paper, H. J. French, of the Bureau of Standards, cautioned that creep tests are no panacea for high-temperature work, also that wide variations in results may be expected from different laboratories, because of different methods of testing and the fact that the investigators may express their findings in entirely different terms.

Some Factors in Furnace Design for High Capacity

BOILER furnace design was discussed by E. G. Bailey, president, Fuller-Lehigh Company, with special attention to the design of furnaces with water-cooled walls protected by metal and refractory blocks.

The principal factors that should control furnace design are: complete combustion with a minimum of excess air, controllable rate of combustion over a reasonable range, long endurance of furnace walls, prevention of slag on boiler tubes, removal of ash.

High combustion rates require temperature, turbulence, and time. The best results are obtained when each of these three is at a maximum. There is an item of cost involved in obtaining each, and the problem is to work out the economic balance for the best all-round results.

Turbulent combustion with minimum excess air produces high temperatures and these facilitate rapid combustion. It is only the damaging effect of the ash from coal that necessitates the reduction of furnace temperature. Limiting the furnace temperature by excess air, is likely to interfere with the major requirement of high efficiency. The tendency today is to use water-cooled tubes in the circulating system of the boiler to cool various parts of the furnace wall or floor as needed. The nature and extent of such water cooling should be chosen with discretion.

Control of the rate of combustion is important and excessive cooling of the furnace interferes with this result. The air supply must be controlled for proper combustion only, with the furnace as hot as possible. Air cooling of the walls, is at best ineffective for high ratings.

Furnace wall endurance, slag on boiler tubes, and ash removal difficulties are closely associated. For either pulverized coal or stoker furnaces there is an ample supply of ash to destroy any wall in a comparatively short time, unless the wall is protected by cooling it below the fusing point of the ash.

The author analyzes the recently published report of the Prime Movers Committee of the N.E.L.A., giving data regarding practically every pulverized coal installation in this country. He plots these data against rate of combustion and fusing point of ash. The results indicate that inconsistent data are being used as a basis for many designs.

The author discusses a number of boiler furnaces in actual service, with numerous illustrations. He includes an extended discussion of performance at the Charles R. Huntley station of the Buffalo General Electric Company, concerning which a report appeared in *Power* for Nov. 22, 1927, page 775. He outlines the experience at that plant with large and small well furnaces and with various arrangements of protected and unprotected wall cooling tubes. Exposed tubes blistered severely after short service and made necessary the replacement of protecting blocks throughout the furnace.

Ash Removal

Ash removal is more of a problem in connection with pulverized coal-fired furnaces than it is with stoker-fired furnaces, and is often a critical point in operation. Allowing molten ash to accumulate on the floor of the furnace to a depth of 6 to 12 in. and intermittently tapping it out as a liquid, as practiced at Buffalo, has many advantages and aids in keeping the furnace hot at the point most needed for high rates of combustion. No serious maintenance problem seems to be involved. The ash is in condition for uses which will return revenue. Ash from other parts of the boiler setting and from economizer and air-heater hoppers can be run into the furnace and melted into the same mass and handled satisfactorily.

Comparison of Results

While the author does not claim to have said the last word, he believes that the methods set forth in this paper furnish a useful means of comparing one furnace with another, and determining approximately what would be the limitations of a furnace if the rate of combustion were changed or a fuel with another ash-fusing temperature were burned.

After discussing a number of basic considerations in furnace design, Mr. Bailey discusses in detail various types of metal and refractory protection blocks designed for the construction of water-cooled furnace walls and floor, and shows curves indicating the temperature gradient observed in blocks of various designs. From these he infers rates of heat absorption in service.

It is desirable in every possible case to have the furnace at as high a temperature as the fusing point of the ash will permit, and no matter what the furnace construction is, if it will retain a film of ash slag, the final wall surface temperature will be substantially that of the fusing point of ash, thereby permitting higher furnace temperature with ash of higher fusing temperature. It is difficult to obtain as good combustion efficiency from coals having ash of low fusing point as from those having ash of high fusing point.

Safety

It is contended that block covered tubes are conducive to safer operation. With the same rate of heat transfer a vertical tube is more likely to burn and blister than an inclined tube with the heat applied on the lower side. It is necessary to have the best possible circulation in water-wall tubes of any kind.

With scale-forming water for makeup, the temperature of the tube is likely to be increased. Just what limits are safe, cannot well be stated at this time. It is reasonable to ask that vertical bare water-cooled tubes for furnace walls should not be subjected to higher rates of heat absorption than the front row of tubes in the boiler itself.

No brief abstract can do full justice to a paper of the length of this one, so replete with detailed information and discussion of operating experience and experimental data. The foregoing abstract is rather a sketchy indication of the subjects touched in the paper.

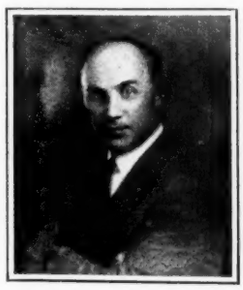
Some Operating Data of Large Steam Generating Units

OPERATING data of six large steam generating units, installed in four plants, are presented in this paper by Henry Kreisinger, research engineer, Combustion Engineering Corporation, and T. E. Purcell, general superintendent of power stations, Duquesne Light Company. All these plants use the storage system of burning pulverized coal.

The operating data are presented graphically and consist of the hourly output in pounds of steam throughout the period of operation. Reasons for shutdown are given, and charts give the necessary data for the computation of the efficiency for various percentages of rating. The authors point out that there is a strong desire among power-plant designers to use large steam generating units for large central stations and to operate them at as high a rating as possible.

Large units present the advantages of lower first cost, lower operating cost and lower maintenance, particularly with properly designed furnaces.

Against large units can be cited the fact that if the unit is disabled there is too much investment idle during the time necessary for repairs. In spite of this objection large units, not only in the boiler room but also in the turbine room, are constantly gaining favor. There are indications that a properly designed large steam generating unit is as reliable as a large turbine generator. In fact, some operators think the steam generator can be kept in service longer.



The desire for high boiler loads is economically justified, particularly for peak-load periods. The first cost is reduced, and through it the fixed charges. The life of power-plant equipment is comparatively short, not because it wears out, but because it becomes obsolete. It seems good economics to get from the equipment as much return as possible during its life, and wear it out, rather than allow it to become obsolete.

The data presented in this paper show that steam generating units large enough to supply steam for 30,000 to 40,000 kw., are in satisfactory operation. The data indicate that still larger units are possible.

The limit to high boiler loads at present seems to be set by the slagging of the first and the second row of boiler tubes, and the choking of the gas passages through the boiler. This limit can be raised by wider spacing of the first two or three rows of tubes, lowering the entrance velocity of the gas into the boiler and avoiding plastering the molten ash on the tubes. This is particularly needed when preheated air is used.

The authors consider the inclined bent-tube boiler as representing an excellent type of design for operation at high rating, as far as the slagging of the boiler tubes is concerned.

Another limit to the high percentage of rating is the power necessary for the operation of the induced-draft fan. However, this limit seems to be high. Considerable power is justified when an extra 100,000 lb. of steam per hour can be made with almost no fixed charges or additional operating labor.

The paper continues with a detailed description of the six boilers for which operating data are given and a discussion of the data themselves. This information should be of value to furnace designers and central-station operating engineers.

Discussion

The discussion was opened by Alex Dow, incoming President, who briefly sketched power developments, especially as related to boilers during the last 39 years, which represents the period during which he has been actively associated with the field. In the early days there was a great variety in boiler types. He had soon discovered the desirability for higher boiler settings with the long-flaming coals of the Middle West and had consistently insisted upon this feature in all his installations. Adaption of the boiler to the furnace has come up as one of the more recent problems. While heretofore holding to the views of the more conservative group as regards the size of units, Mr. Dow expressed the opinion that his next plant would likely fall into the maximum output class. He does not consider stokers versus pulverized coal as vital until extremely high outputs are reached, and advanced the theory that dissociation of water in the tubes accounts for present high rates of heat abstraction.

The papers by Messrs. Kreisinger and Purcell, and Bailey were discussed jointly.

F. E. Moultrop called attention to the fact that while there are now only four 1,200- to 1,400-lb. boilers in central-station service, as many more are on order and several industrial plants have also gone to comparable pressures.

Curves presented by M. W. Engle, of the Edison Electric Illuminating Company of Boston, in which B.t.u. per kilowatt-hour were plotted against years, for a 60,000-kw. station, showed a steady decrease from over 23,000 B.t.u. in 1913 to about 13,000 in 1927. While the fixed charges have increased during the last seven years, the dollar efficiency has increased. The boiler plant now represents about 40 per cent of the plant cost. Touching upon the tendency toward fewer and larger boilers, the speaker could see no reason why single boiler units would not in the near future serve up to about 75,000-kw. turbine units.

H. M. Cushing regarded the fusing temperature of the ash as one of the most important factors with pulverized coal. At the Huntley Station in Buffalo, which employs a slagging furnace, this temperature runs from 1,900 to 2,200 deg. The additional boilers on order for this station will be 20 per cent larger than those now in operation and will be designed on the basis of 40,000 B.t.u. per cubic foot of furnace volume.

The question of boiler rating came up for discussion, in which it was pointed out that, with the increasing use of water walls, economizers and air preheaters, the old practice of rating on the basis of boiler heating surface becomes meaningless. Three widely differing ratings

were thus possible in the tests mentioned in Mr. Kreisinger's paper according to whether convection surface, radiating surface or a combination of both were assumed as a basis.

Purity of feed water becomes an absolute necessity with the present practice of forcing large boilers, and in this connection condenser leakage must be watched closely.

Touching upon experiences at Cahokia, H. G. Theilscher quoted figures to show a marked decrease in unit investment cost covering the three sections completed since 1922. These were of the order of 100, 86 and 72. Although the output has been doubled during this period, the economy has increased. In the latest section three boilers supply one 50,000-kw. turbine. A recent eight-hour test of one of the 18,000-sq.ft. boilers equipped with water walls and a 10,000-sq.ft. air preheater gave a combined efficiency of 85.9 per cent at an output of 170,000 lb. of steam per hour. The corresponding average CO_2 was 15.8 per cent, combustible in stack dust 8.6 per cent, and stack temperature 265 deg. This was with Kentucky coal of 11,437 B.t.u. ground to 68 per cent through a 200-mesh screen. The power consumed in coal preparation was 17.7 kw.-hr. per ton.

Speaking for the industrial plant, G. B. Randall told of the installation at the plant of the National Cash Register Company in Dayton. Here a Stirling boiler setting, previously served by an old type stoker had been modified for pulverized coal served by a unit mill. The furnace is diamond-shaped, refractory lined and has a water screen at the bottom which is made up of heavy gage tubes. These have stood up exceptionally well in spite of direct flame impingement during a four-month period before the flame length was finally shortened. Mr. Randall was of the opinion that relatively small boilers and low use factors make water walls too expensive for many industrial plants.

The modern stoker for big boilers was championed by J. G. Worker, who took issue with Mr. Kreisinger's statement that stoker-fired units for extremely large capacities should not receive consideration. He claimed that the Gould Street Station cited by the author had not attained the expected capacity which could easily have been reached with stokers.

With regard to the trend toward large boiler units, the suggestion was made by V. E. Alden that a study be made of outages, similar to that made of turbines a few years ago. Among the factors that will reduce maintenance and consequent outages are, more effective ways of reducing slag accumulations, keeping solids out of the circulating system, keeping down moisture carry-over into the superheater, more effective methods of ash removal, and ease of control and reliability of the draft fans.

Steam Tables Research

AT THE annual meeting to hear reports on the progress of the extended co-operative research on the properties of steam, a small group of men of highly technical interests were privileged to participate in an historic gathering. During a brief two hours there was presented more reliable information on the thermal properties of high pressure steam than had been made available in the history of the world theretofore. More precise values of data previously available were likewise made public. Among these it is perhaps noteworthy to remark that the best value of the mechanical equivalent of heat, based on the latest experimental work at the Bureau of Standards, now seems to be 778.4 ft.lb. per B.t.u.

At the Bureau of Standards, Dr. N. S. Osborne is supervising experimental work for determining the heat content of saturated water from the ice point to 572 deg. F., where the pressure is about 1,200 lb. per sq.in. The calibration of the apparatus for the lower portion of the range has been completed, and values have been reestablished for the fundamental units and for the properties of the saturated liquid up to the atmospheric boiling point. The residual error is believed to be less than 1 in 5,000. Later studies will yield data on the heat of vaporization through the same range of pressure and temperature. In addition there may be a slight extension into the superheat field.

Dr. L. B. Smith presented results obtained at the Massachusetts Institute of Technology on pressure-volume-temperature relations for superheated steam for volumes from 0.08 to 0.32 cu.ft. per lb., for pressure from 1,350 to 3,800 lb. per sq.in., and for temperatures from 590 to 720 deg. F. These results, embodied in a single page of typewritten tabulation, have served as the basis of an invaluable extension of the steam tables and diagrams published by the General Electric Company some two years ago. This work was described by J. H. Keenan, Jr., of that organization. Through his work the information coming from the laboratory of the scientist is being made available for the engineering profession without delay.

E. L. Robinson, also of the General Electric Company, presented data on reheat factors for steam turbines recalculated by Prof. R. E. Clark, of Cornell University, on the basis of the most recent data on the properties of steam.

Dr. Harvey N. Davis, of Harvard, described his tedious work of calculating and co-ordinating experimental data to secure the best smoothed values of the final results that will appear ultimately in the steam tables.

Throughout the session the liveliest interest was evident, extending even to intricate discussions of the more highly technical phases of laboratory refinements and the mathematical correlation of results.

While the details of the conduct of this highly specialized experimental research are beyond the experience and interest of the steam power engineer, he yet must recognize the immense importance of dependable steam table data, to which this work is fundamental.

George A. Orrok, chairman of the committee that is guiding the destinies of this work, reported on the general situation of the project and expressed the hope that new contributors might be found and that more old contributors might follow the example of a few and subscribe second contributions to the end that the work so well begun may be carried to a completely successful conclusion.

Commercial Development of Low-temperature Carbonization

UNDOUBTEDLY, the feature of the fuel session, held on Wednesday morning, was the description of a commercial low-temperature plant which is at present under construction in this country. For several years now this method of coal treatment has hovered on the verge of commercial development. The fact that it is finally to be put to use holds for power engineers much interest, for the undoubted result will be much information as to whether this type of coal treatment is eventually to be of use in providing power plants with a cheaper and more nearly smokeless fuel.

Plant at New Brunswick to Use K.S.G. Process

Faced with economic conditions different from those in the United States, German experimenters with low-temperature carbonization processes have pushed their work through to successful commercial development. Although America lacks the same economic urge that has caused Germany to make this development, it is natural that processes that have been successful in that country should be brought to this country. One of these is the K.S.G. process, the American rights of which are controlled by the International Combustion Engineering Corporation, through a subsidiary, the International Coal Carbonization Company. Dr. Walter Runge, vice-president of the above company, gave a paper on Wednesday morning describing the first commercial installation of this process in this country, which is now under construction at New Brunswick, N. J. This plant is under contract to furnish the Public Service Electric & Gas Company, of New Jersey, with a minimum of 3,000,000 cu.ft. of gas daily, and has made contracts with the F. J. Lewis Manufacturing Company, for the disposal of all the tar and light oil produced, estimated at 15,000 and 1,800 gal. a day, respectively.

Interest for power plant engineers in this development lies in the products of this process and their value. The coke produced, about 80 per cent lump and 20 per cent fines, is claimed to be a high-grade fuel, smokeless in combustion. The revenue from the gas, tar and oil produced seems to promise sufficient return so that raw coal could be treated by this process, the coke being burned under boilers and the other products sold. In summarizing possible American conditions, the paper states that the cost of processing will amount to about $2 a ton and that the revenue from the byproducts will be from $3 to $3.50 a ton.

The present plant is to be operated in connection with a gas works, but the information on yields and costs obtained there should be valuable in indicating whether this process can be adapted to power-plant uses.

Discussion on this paper was along two general lines: First, as to whether a process that has proved successful in Germany can be successfully adapted to the different fuels and economic conditions that prevail in America; and second, as to just what the details of the process and its yields are. Prof. A. G. Christie suggested that European processes, to be successful in this country, require much development work, and that it is probable that the K. S. G. process will be no exception to this rule. He pointed out that with a yield of 70 per cent of coke per ton carbonized, of which 80 per cent is salable lump, only 56 per cent of the original coal would be available in the form of a satisfactory fuel coke. He also pointed out that the estimates for realization from this process were only good in the eastern part of the country, where consumers are accustomed to a high-priced smokeless fuel.

Discussion by W. H. Blauvelt, brought out a number of questions: Will the process handle non-coking coals? Has the process flexibility of control enough to permit the use of various fuels? If so, how is this control effected? Is the coke available for firing power plants? Are there markets for the tar products in this country?

R. B. Kleinschmidt called attention to the fact that the economic success of any method of coal processing depended on a profitable market for the byproducts. He stated that, in New England at the present time, gas companies are burning their tar as fuel because there is a glut of tar on the market, and this does not promise success for a process depending on the sale of a large quantity of tar. Vapor-phase cracking of oils gives products that are substitutes for coal-tar products, and with the present low price of oil these can be sold at a reasonable figure. But it has proved to be impossible to market the products of even a small plant of this type. The speaker also pointed out that coke ovens necessarily produce a larger amount of domestic coke than they can readily dispose of. Such coke is now selling in the Boston market at $12 a ton, which will provide severe competition for any other type of smokeless fuel. In addition, the rapid spread of oil and gas firing for domestic heating plants further restricts the possible market for a smokeless fuel.

In his answer to this discussion Doctor Runge pointed out that the adaptability of American coals to foreign processes need not be questioned, since such equipment as foreign-designed coke ovens and vertical retorts have operated successfully in this country. He said that the K. S. G. process is limited to strongly coking coals, but can be varied somewhat in control to suit different grades of such fuel. He felt confident that the estimates of costs and revenue given in the paper were conservative. As to the market for the tar, this tar is different from high-temperature tar and should find good outlets in flotation work, wood preserving and the manufacture of products similar to Bakelite. Tests made by John Anderson several years ago show that low-temperature coke gives 2 per cent better efficiency than coal when used in the pulverized fuel burner for steam generation. The dust difficulty has been overcome by a slight change in the design of the retort.

Report of Joint Committee on Boiler Feed Water

SPONSORED by the American Boiler Manufacturers Association, the American Railway Engineering Association, the American Waterworks Association, the National Electric Light Association, the American Society for Testing Materials and the American Society of Mechanical Engineers, a joint research committee on boiler feed-water studies is co-operating actively in a study of the various processes employed in the purification of feed water for steam power plants. An attempt is being made to determine the fundamental principles underlying certain phenomena that take place in steam boilers. This work is carried on by a number of subcommittees, each charged with certain specific researches, and is under the guidance of an advisory committee. There follow abstracts of the annual reports of the advisory committee and the various subcommittees that have been actively engaged during the past year as given at the Thursday afternoon session.

Progress in Boiler Feed Water Studies

The most important point brought out in the report of the advisory and editing committee, given by Sheppard T. Powell, is that the work of this committee has reached a point where further active progress cannot be made unless funds are raised for carrying forward the necessary researches. The committees requiring such assistance at this time, in order to make further progress, are those to which have been assigned the problems of corrosion, embrittlement, priming and foaming, and condensers, evaporators and deaërators. Because these problems are nationwide in scope, it is the opinion of the committee that the financing should not be borne by any individual group or confined to any restricted area. It is also put forth that the financing of these research studies is a sound investment which will bring an ample return to power plants in the form of reduced maintenance cost and higher efficiency in the operation of their equipment.

This report also points out that present tendencies in the design and operation of steam generating equipment are having a marked influence upon the question of feed-water treatment. Ten or fifteen years ago the majority of feed-water problems consisted largely of the removal of scale. The control of this problem is no longer an important one, since equipment for the elimination of scale is now available. Also, the deaëration of feed water has done much to correct corrosion troubles. However, feed-water troubles have not been eliminated in all cases by the installation of deaërators. The corrosion of economizers and boilers, in the absence of oxygen; the production of hydrogen and oxygen by direct ionization of pure water, and the embrittlement of boilers at relatively low pressures, are some of the problems that are confronting boiler operators under modern conditions.

Subcommittee No. 1, whose assignment is sedimentation with and without chemicals, pressure and gravity filters and deconcentrators, and continuous blowdown apparatus, made a report dealing with the present development and trend of various means used to maintain the concentration of suspended matter and dissolved solids within workable limits.

The committee finds two methods in use which are helpful to a certain extent. The first of these consists of a small pressure filter through which a portion of the water from the boiler is passed continuously while the boilers are in operation, with return of the clarified water, and is called a "deconcentrator." This deconcentrator system requires but little space and has a low initial cost for installation and low operating cost. It saves some of the heat in the blowdown water through the return of clarified water under pressure, makes a reduction in blowdown due to higher allowable concentration of alkali salts and is adaptable for improving internal treatment conditions by providing means for the removal of sediment and suspended matter. On the other hand, there is necessity of frequent backwashing of the filter. When the boiler water contains much suspended matter, relatively high rates of filtration are necessary to handle the volume through the small effective filter area and operating difficulties are increased due to the maintenance of a series of filters and pumps when this system is installed on a number of boilers.

The second plan involves the sedimentation and settling of small, continuous blowdown with the return of the recovered condensate to the boiler and the wasting of sludge and highly impregnated concentrate. This system is termed a "stabilizer" and consists of two parts: An upper chamber into which the boiler water is led, acts as a splash tank, separating the steam liberated from the boiler water, the steam being reclaimed; the lower part is a closed counterflow heat exchanger in which the heat of the sludge water is recovered before the sludge is discharged from the bottom. This method is said to have advantages in small space and low cost, partial saving of the heat, smoothness in boiler operation due to maintaining a more constant density of the water in the boiler, and adaptability for improving internal treatment conditions by providing means for sludge removal and control of alkali salt concentration. The disadvantages of this system are the necessity of a check to prevent waste from the continuous blowdown and the maintenance and cleaning of both the upper compartment and the tubes of the closed heat exchanger.

The committee, in closing its report, recommends that the subject holds sufficient promise to warrant special study and research on existing devices and practices used in this country and in other countries. It is felt that there is a considerable field for effecting economy in power plant operation by means of a suitable system for controlling boiler water concentration.

Standardization of Nomenclature

Subcommitee No. 2, whose assignment is water softening by chemicals (external treatment), presented a report on the standardization of nomenclature employed

in the field of water softening. This report consisted of definitions of terms and names of devices and their parts. In general, it follows the manual of the American Railway Engineering Association, although in some cases better-known definitions have been adopted. In other cases certain changes were thought necessary in the existing definitions. These definitions were submitted in tentative form by the committee, and suggestions and additions are solicited to help in the completion of their work.

Working Hypotheses for the Study of Foaming

Subcommittee No. 3, whose assignment is zeolite softeners, internal treatment, and priming and foaming, reported that progress in their investigations is necessarily slow, because the members of the committee are unable to give the time for the comprehensive experiments that must now be carried out before definite conclusions can be drawn. This committee is awaiting the availability of funds that will permit the proper carrying out of this research work. Progress has been made in the development of new working hypotheses for the study of foaming. The first of these hypotheses is that detached liquid films are always formed by two already existing liquid surfaces approaching each other until a condition of equilibrium is reached, as the result of a balance between the forces which cause the surfaces to approach and another set of forces which act in the opposite direction. The second hypothesis is that film formation and film stabilization, though frequently intimately associated, are separate phenomena.

Effect of Industrial Wastes

Subcommittee No. 7, whose assignment is municipal water supply, reported on the effect of industrial wastes on boiler feed-water problems and condenser operation. This report mentions three new methods of treatment of municipal water supplies that should be of interest to power-plant operators. These are the recarbonization of chemically softened water, the use of sulphur dioxide for decolorization and for assisting coagulation, and the use of sodium silicate to inhibit corrosion.

Many of the problems arising in the use of industrial water supplies for boiler feed water are extremely difficult to control, since the cost of treatment of some of the industrial wastes responsible for the trouble would impose a great hardship on those to whom they are due. These problems may be minimized, however, by the constructive and sane program of co-operation and education which can be brought about only through an intelligent conception of the economic importance of the problem. Lack of co-operation and ignorance as to the importance of these matters are frequently responsible for the beginning or continuation of the pollution of many otherwise excellent water supplies.

Standard Methods of Water Analysis

Subcommittee No. 8, whose function is to prepare standard methods of water analysis applicable to stationary and railroad practice, made certain recommendations as the result of the last year's study of this subject. It is indicated that for pure and distilled waters the original Winkler method is most satisfactory, and that for water containing nitrites and iron salts the modified Rideal-Stewart method is in favor. The accuracy of both these methods for dissolved oxygen has been questioned, and is a subject for further investigation. However, until some further work is done, it is suggested that much care be employed in collecting samples. Rules to be observed in the collection of samples are being formulated by this committee.

The present test for CO_2 is unsatisfactory, although the A.P.H.A. test, in the absence of a better one, should be used, and meets some requirements.

Tests on Forged Steel Penstock Pipe

AT THE Big Creek plant of the Southern California Edison Co., the head will be over 2,400 ft., giving a pressure of 1,050 lb. on the lower sections of the penstock. From the point in this penstock where the head is 1,644 ft., to the water-wheel nozzles the pipe is forged steel sections with integral coupling flanges. Before contracting for this pipe, which varies in diameter from 66 in. to 34 in., the power company arranged for the manufacture of a typical 66-in. section of the pipe and for its being tested to destruction, to determine its behavior under high pressure. In a paper, "Destruction Test of a 66-In. Forged Steel Penstock Pipe," John L. Cox gave the results of these tests.

The test pipe was 13 ft. $5\frac{1}{2}$ in. total length, with a section 8 ft. long between the flanges turned to normal pipe dimensions of 66 in. inside diameter with a $3\frac{1}{2}$-in. wall. Under test the pipe reached its elastic limit at a pressure of 2,150 lb., corresponding to a tangential stress of 25,000 lb. per sq.in. in the steel of the wall. The measured proportional limits of the steel at the ends was 24,500 lb. The pipe failed at a pressure of 5,300 lb., which by the approximation of the extended Birnie formula, would correspond to a fiber stress of 62,000 lb. per sq.in., compared to an actual strength of 67,750 lb. The external expansion was 6 in. in diameter, or 8.3 per cent. The internal expansion was $6\frac{3}{8}$ in., or 9.63 per cent. At the mid-length of the pipe section, at the fracture, the reduction in the wall section was $\frac{3}{16}$ in., or 6.25 per cent.

From the results of these tests the author states that "It is seldom that an opportunity is afforded engineers for comparing the elastic limit and breaking strength of a large forging with that of its representative tests bars, and it is encouraging to note that they appear to be in such good accord. A foundation is laid for confidence that test bars properly located will truly indicate the average behavior of the metal in the large forging from which they may be taken.

"The pronounced expansion shown by the seamless forged-steel pipe tested indicates both that it is an eminently safe type of pipe, able to bear excessive loads without fracture, and that it may be relied upon to give ample warning of danger in case of weakening through corrosion or otherwise."

In closing Mr. Cox disclosed that the break had occurred suddenly and in one sudden crash.

New Developments in Oil and Gas Power

A FULL attendance Thursday afternoon at the session of the Oil and Gas Power Divisions, indicated the interest that is being taken in developments in this field.

Papers presented gave a detailed theoretical analysis of ideal cycles for Otto and Diesel engines, including a series of curves from which it would be easy to establish efficiencies that would be essentially correct; the suggestion of constructing the cylinders of locomotives so that they might be used either as steam or Diesel cylinders, and a résumé of progress in the field including comment on trend in design, research, the needs of the industry and the outlook. An incident was the presentation to William J. Joachim of the Rudolph Diesel Award for the best paper delivered during "Oil and Gas Power Week of 1927."

Efficiencies of Otto and Diesel Engines

DETAILED theoretical analysis of the ideal cycles for Otto and Diesel engines was presented by F. O. Ellenwood, professor of heat power engineering, Cornell University, as the result of studies conducted by him and F. C. Evans, formerly assistant professor, and C. T. Chwang, formerly a graduate student in the same department. This paper, whose mathematical and theoretical nature does not permit of ready abstracting, should prove of exceptional interest to designers and large users of internal-combustion engines. After setting forth at length their assumptions and equations, the authors give the results of complete calculations for 65 assumed cases covering a range of values more than sufficient for present practice, followed by a number of tests of actual engines for comparison with the ideal performance.

For all cases the ideal cycle efficiency is increased materially by a large air-fuel ratio and a high compression ratio, the nature of the fuel used being of only secondary importance.

The authors advocate increasing use of the "engine efficiency"; that is, the ratio of the thermal efficiency of the actual engine to the thermal efficiency of the ideal cycle. This figure expresses better than the thermal efficiency of the actual engine the degree to which that engine approaches the best possible performance of which it is theoretically capable. It is interesting to note that one of the engine tests given in this paper indicates an actual brake engine efficiency of slightly over 76 per cent.

An important advantage of using the engine efficiency is that the same numerical result is obtained with either the lower or the higher heating value of the fuel used in the test of the real machine and in the calculation of its ideal cycle. The authors advocate the use of the lower heating value in the calculation of engine performance, both real and ideal.

The results obtained by other investigators are discussed, and it is shown that most of the outstanding discrepancies are explained by variations in the initial assumptions. Considering the complexity of the problem, the results obtained by various authors are for most cases in sufficiently close agreement to justify the hope that some of them, or a combination of them, may be accepted as standards by the A.S.M.E., or that at least they will serve to promote additional study and interest.

This paper represents a considerable volume of extremely painstaking work by the authors and their associates and should prove of distinct value to those who are concerned with the efficient performance of internal-combustion engines.

Discussion

Prof. L. C. Marks led the discussion with comment on the desirability of standardizing, if possible, gas engine efficiency. This was entirely possible with a steam engine or a turbine, but with the gas engine two uncertainties, such as the cycle and the composition of the working medium, entered into the calculations. Of the gases to be considered little was known about the specific heat at high temperatures and pressures and about equilibrium conditions from disassociation. With the possibility of error up to 18 per cent in engine efficiency, he did not think any attempt should be made at this time to establish ideal efficiencies. It would be better to wait until such time as the specific heat values for CO_2 and the other gases had been more closely established. In the meantime use of the hot air standard should be made. Professors Goodenough, Baker, Upton and others thought that the air standard should be abandoned and a real mixture standard established.

Progress in Oil and Gas Power Engineering

CONTRIBUTED by the Oil and Gas Power Division, this résumé was an interesting review of developments in the various fields in which Diesels are being used. Generally, the present trend was unmistakable toward higher speed in order to obtain more power per pound of engine weight, the incentive being the conquest of the mobile field for the heavy-oil engine.

Use of engines of the hydraulic (solid) injection type was increasing. Out of the total horsepower of stationary engines built in this country, 53 per cent was of the airless injection type in 1924, 56 per cent in 1925 and 58 per cent in 1926, excluding the low-compression engines.

The struggle between two-cycle and four-cycle was still undecided, the respective figures for American stationary engines for the last three years being as follows:

	1924	1925	1926 (Estimated)	
Two-cycle	42	51	49	Per Cent of
Four-cycle	58	49	51	Total Horsepower

In marine application the two-cycle seemed to gain over the four-cycle, while for locomotives the opposite was the case. The most spectacular advance, however, had been made by the double-acting principle. Not long ago double-acting engines were considered experimental, but now there were six different makes of double-acting engines in operation at sea and five more in an advanced degree of development.

With regards to construction, a trend toward more rigid frames was noticeable. The A-frame was being displaced by the box frame with individual or cast-in-block cylinders. Rigid connections between the individual cylinders or cylinder heads frequently served the same purpose. The reduced vibration and bearing wear achieved with the rigid construction justified the additional expense.

The chain drive of the camshaft, introduced not long ago, had won further adherents.

The use of aluminum and alloys for pistons was being tried with promising results. The use of high-grade materials for other engine parts, together with refined finishing methods was progressing, especially with high-speed machinery.

Efforts were being made to secure higher mean effective pressures for two-stroke-cycle engines. Crankcase scavenging was slowly losing ground, while the use of blowers was gaining for both charging two-stroke-cycle and supercharging four-stroke-cycle engines. At present the employment of blowers was restricted to large engines, but their introduction of medium and small engines was predicted.

In the controversy over direct spray injection as against a precombustion chamber, both parties were holding their ground, and no gain for either could be recorded as having been accomplished during the year that is just passing into history.

New injection systems were still being introduced and a perplexing number of varieties were available. Some of those recently developed took a middle place between the direct pump injection and the accumulator (common rail) system, by accumulating with each pump stroke only fuel enough for one injection, and using a mechanically operated valve for timing the injection.

Referring to Diesels for peak service, it was admitted that unless favored by particular local conditions, the Diesel engine could not compete with steam and water turbines for large power generation. On the other hand, both calculations and experience had shown that their combination with steam and water power for peak loads and emergencies offered decided economical advantages. For short-period operations, the higher fuel cost of the Diesel was more than offset by its lower interest on first cost compared with water power and by its lower cost of keeping it prepared for emergency, compared with steam power. The water-power central station at Bremen had installed two 3,000-hp. Sulzer Diesel units to cooperate with water turbines. The 4,500-hp. Diesel set of the Societe des Forces Motrices du Refrain operated satisfactorily together with water and steam turbines. The possibilities of the Diesel engine for central stations were not yet fully realized.

For the future the outlook was promising. The oil-engine industry, which survived in spite of numerous handicaps might look for something better if the handicaps were removed. Technical progress was satisfactory, and with intelligent effort it would be accelerated. A tremendous market was available of which only a small fraction had been exploited so far.

Lubrication Research

AT THE session on research a symposium was presented on lubrication. A paper, "Progress in Lubrication Research," contributed by the A.S.M.E. Special Committee on Lubrication, summarized the activities of the committee during the five years elapsed since the previous, or third, report submitted by this committee. The first experimental problem undertaken by the committee consisted in determining the effects of pressure on the viscosity of lubricating oils. Lard oil, castor oil and three mineral oils were tested at various pressures and temperatures up to about 50,000 lb. per sq.in. and 140 deg. C. The result of these tests were presented in a paper by M. D. Hersey and Henry Shore. Other investigations have been conducted by R. V. Kleinschmidt, using sperm, lard, castor, rape-seed oils, three mineral oils and one cutting compound at pressure up to 130,000 lb. per sq.in. and 80 deg. C.

At a temperature of about 22 deg. C. lard oil solidified abruptly on passing through a critical pressure of about 22,000 lb. per sq.in. The parafin-base oils showed a similar effect. For all of the oils tested, except lard oil, it was found that the temperature coefficient of viscosity is considerably increased under moderately high pressures.

A paper on "The Effects of Running-In on Journal-Bearing Performance," by S. A. McKee, gave the results of an investigation conducted by the Bureau of Standards, the object of which was to evaluate the effect of running-in upon the performance of babbitted, full-journal bearings. A specially designed journal-bearing friction machine provided a method of measuring the friction loss in a journal bearing when operating under different conditions of load on the bearing, speed of the journal and viscosity of the lubricant. The results indicate that running-in causes a marked reduction in friction loss of a bearing under severe operating conditions. The hypothetical example of a turbine bearing is used to show how it may be possible to put the running-in effect to use in saving power in high-speed machinery.

G. B. Karelitz, in a paper, "An Investigation of the Performance of Waste-Packed Armature Bearings," gave the results of research made with full-sized railway-motor armature bearings. The conclusion is reached that although it is true that the waste and oil supplied at present are not as good as they formerly were, it is yet possible to obtain good performance from these bearings.

Lubrication Discussion

In the discussion the need for more basic data on bearing lubrication was emphasized. The research work now being carried on gives promise that it will in the near future answer many of the problems in lubrication

that now very little is known about. When the sudden change of oil to a solid, when subjected to pressure, can be explained, it will account for many of the phenomena in the action of lubricants and will open up new fields of investigation. Attention was called to the lack of funds to carry on this research work, and cases were cited where it had to be abandoned for the lack of a few hundred dollars.

The advisability of using a lighter oil in a bearing after it had been run in, to increase the efficiency, was questioned. Steam turbines operate for considerable periods during starting at reduced speeds. At full speed an oil film might be maintained to give adequate lubrication with the lighter oil but at the lower speed the viscosity of the oil might not be sufficient to prevent metal to metal contact in the bearing. It was suggested that the difference in the temperature of the oil under the two conditions of speed might be sufficient to take care of conditions obtaining at different speeds satisfactorily. In turbine bearings the lubricating problem is quite a serious one, as journal speeds up to 150 ft. per sec. at 180 lb. per sq.in. had to be contended with.

Heating of the oil as it passes through the bearing was pointed out as something that should be given more attention. During this period it is subjected to severe treatment and its temperature is increased about 15 to 25 deg. C. In this process the oil loses one-half to two-thirds of its viscosity when in the film.

In waste packed bearings, the kind of waste used was considered an important factor in satisfactory lubrication. Wool waste, on account of its resiliency, is superior to any other kind. Cotton waste soon falls away from the journal and results in a lack of lubricant. In the paper it was complained that the oils and waste today were of a poorer quality than they were a few years ago, but the discussion showed the opposite to be true, particularly regarding the lubricant. The demand of industry places more and more exacting requirements on lubricants, and their quality must be improved to meet these needs it was argued.

Hydraulic Session Discusses Centrifugal Pumps

TUESDAY afternoon an entire session was devoted to a symposium on centrifugal pumps. The large attendance and character of the discussion indicated the interest of manufacturer and operator in this subject and justified the judgment of the committee in arranging for a separate session.

The symposium consisted of three papers, one a general discussion of centrifugal pumps that reflected English practice and theory, and two papers that dealt with methods of analyzing pump losses.

Centrifugal Pumps

A GENERAL dissertation on centrifugal pumps was presented in a paper by H. T. Davey, Bexley Heath, Kent, England.

He classifies the losses in a centrifugal pump as hydraulic and mechanical. Those losses which arise due to the presence of the fluid may be called hydraulic losses, while losses such as friction at bearings may be called mechanical losses. The friction of the disk rotating in the fluid contributes to a large extent toward the hydraulic losses.

One of the chief influencing factors in regard to the disk friction is the clearance between the faces of the disks and the casing. It has been shown by experiment that as the clearance increases, so the friction increases, therefore the clearance should be kept down within reasonable limits compatible with the mechanical requirements. The condition of the surface of the casing and the disk has an effect upon the friction, but it is doubtful if the extra cost of producing highly finished machine surfaces pays, since ordinary painted and varnished faces seem to be just as satisfactory. A method for calculating disk friction is described in the paper.

The effect of putting vanes on to the disk is to increase the friction. There will also be a slight frictional loss due to the flow through the rotor. This, however, will be comparatively small. The friction of the water flowing around the volute will also account for some loss of power and can be approximately computed from the length of the volute and its diameter.

Mechanical losses will depend on the type and condition of the bearings and the kind and condition of packing used in stuffing boxes. The fit of the impeller in the casing will also have some effect. The actual magnitude of these losses can be determined by running the pump without load and determining the actual power absorbed.

It is important to realize that the efficiency of a centrifugal pump depends largely upon the design of the volute. Its duty is to change into pressure the energy of the fluid given to it by the impeller.

It has been established by practical tests that best results are obtained when the velocity of flow in the volute is between $0.3\sqrt{2gH_m}$ and $0.4\sqrt{2gH_m}$. The cross-sectional area of the rotor should be designed so that the velocity at all sections is constant and does not exceed the values given by the formula.

In order to prevent the water flowing through the volute being driven round the casing, a stop or cut-water is necessary. There should be a good clearance between the cut-water and the impeller, otherwise vibration may occur.

In the case of the turbine pump the main casting is arranged so that guide vanes can be fitted. These guide vanes are provided so that the area of water way from the outlet of the disk gradually increases outward and thus the velocity of discharge falls. In these pumps the tips of the vanes on the disks are often radial at discharge.

In order to reduce the velocity of flow along the delivery pipe and obtain as much pressure energy as possible from the available energy, the usual practice is to enlarge the delivery branch of the pump to such an extent that the velocity of the flow in the pipes does not exceed 8 or 10 ft. per second. A common rule is to make the delivery pipe area twice that of the throat.

Whenever possible, the suction pipe should be short. The best pumps obtainable will not work satisfactorily with suction heads greater than 25 or 27 ft. The best results will be obtained if the velocity of the water entering the suction pipe is about 3 ft. per second, and on reaching the pump is increased to about 6 or 8 ft. per second. In ordinary types of centrifugal pumps the best efficiency will be obtained when the peripheral velocity of the disk is about $0.9\sqrt{2gH_m}$ for pumps with guide vanes and radial exits vane tips. For pumps having plain volutes the best peripheral speed is about $1.1\sqrt{2gH_m}$, when the vane tip angles are about 40 deg.

In all cases the eye of the pump must be large enough to allow the passage of the whole of the water at a velocity about equal to that in the suction pipe. For general purposes the diameter of the disk can be made about two times that of the eye.

The required number of vanes will depend on the speed of the disk. For general purposes 8 to 12 vanes will suffice, but where high speeds are to be used, 12 to 24 vanes may be necessary in order to avoid excessive slip. Vanes should be made as thin as is conveniently possible; about $\frac{3}{8}$ to $\frac{1}{2}$ in. is suitable. The best velocity of flow through the disk is about one-fourth of the peripheral speed, but often lower speeds will be found practicable, particularly in the high-speed pump.

The glands necessary to prevent excessive leakage should always be bored with a slight clearance and the length of the stuffing boxes should be about equal to the shaft diameter. The best packing for pump stuffing boxes is rawhide. With this material the shaft suffers no scoring and rings can easily be replaced or added to the stuffing box.

A New Method of Separating the Hydraulic Losses in a Centrifugal Pump

IN THIS paper M. D. Aisenstein, hydraulic engineer, Byron Jackson Pump Manufacturing Company, presented a method for determining separately the hydraulic losses in a centrifugal pump from the head capacity curve as found by test.

The losses are classified as friction and shock losses. The friction losses are those due to resistance afforded to the water by the walls of the runner and case. The shock loss may be considered as due to enlargements of pump passages.

Starting with the equation of total head as given in the classical one-dimensional theory, the author derives an equation for actual head in terms of capacity in cubic feet per second, which contains various constants. This equation contains three terms representing, respectively, total theoretical head, friction and shock losses.

An illustrative example is given in which the author shows how all the various constants of the equation he has derived may be obtained from the characteristic curve. With these constants determined, the friction and shock losses follow by substituting the vaives of the constants found in the equation.

A knowledge of how these losses are distributed allows the designer, by studying the variation of these losses, to decide in which direction improvement should progress.

A Method of Analyzing the Performance Curves of Centrifugal Pumps

USING the classical one-dimensional theory of centrifugal pumps as a guide, Joseph Lichtenstein, Bethlehem Ship Building Corp., has developed a method of analyzing pump performance curves, whereby the factors necessary to make theory and practice agree can be determined. The correction factors chosen have a real physical meaning, expressing the reasons for the difference between theory and practice.

In an actual pump the water does not leave the blade tangentially, as is found in the one-dimensional theory, but at an angle always smaller than that of the blade. This is one of the material reasons for the deviation between theory and practice, and a knowledge of the water angle for every given blade angle is of great importance for the centrifugal pump designer. It is shown how this leaving angle of the water may be determined from ordinary pump performance curves.

The author indicates that in a pump having a definite number of blades there is a flow of water rotating within the blades and in a direction opposite to the rotation of the impeller. At the periphery the direction of this whirl is opposite to the rotation of the impeller, and therefore its velocity is opposite to the component of the absolute velocity. The whirl component, it is shown may also be deduced from tests.

The classical theory does not neglect the rotation component at the entrance of the pump, but practice generally does in assuming the absolute entrance velocity normal to the preferential velocity. The author, however, considers this factor in his paper and suggests that the analysis of given tests will show its magnitude.

The factors so far mentioned are correction factors for the impeller alone. The impeller, however, does not determine a pump's capacity and head at the point of highest efficiency. The case determines this, and it is shown how the volute and the impeller are interrelated for given conditions of capacity and head.

In the derivation of the various equations, several interesting relations are disclosed. It is shown that the tangent to the characteristic capacity curve, at the point of maximum hydraulic efficiency, intersects the capacity axis at the same point as the total head straight line. In connection with the brake horsepower curve it is indicated that for any point of capacity the tangent to the brake horsepower curve and the tangent to the curve of total hydraulic energy are parallel. At the absolute point of maximum total efficiency the tangent to the brake horsepower curve and the tangent to the water horsepower curve intersect at a point lying on the capacity axis. It is also shown that the curve of total hydraulic energy has its maximum at the same capacity as the

brake horsepower curve and intersects the axis at twice its capacity.

Applying these relations to the performance curves as found by tests, and by using other derived equations, the author illustrates his method of analysis by determining separately the various correction factors.

The knowledge of these factors for a series of pumps will enable the designer to calculate a pump for any condition with a high degree of accuracy and to answer any questions that may arise in pump practice, such as changing the impeller in a given pump, changing the volute for a given impeller or turning down the blade of a given pump.

Discussion

W. M. White opened the discussion by calling attention to an error in Fig. 6 in the paper by H. T. Davey, which shows the rotation of the impeller in the wrong direction. The author's statement that turbine pumps having casings with guide vanes are the most efficient type of pump, he believes is inaccurate.

In commenting on Lichtenstein's paper, he complimented the author on the workmanlike manner in which the paper had been prepared, but nevertheless felt that the method was too complicated for use in the routine rush of a pump design drafting room. He disagreed with the author's statement in regard to the whirl flow within the impeller vanes. In connection with the volute, attention was called to the author's assumption that the water flow followed the contour of the casing.

Prof. R. W. Anders cited tests that indicated the formula used by Aisenstein for friction head to be inaccurate for wide ranges of capacity. He also questioned the accuracy of the equation given for determining shock losses and gave a correct equation for this loss. That the losses at entrance to the impeller had been neglected was also pointed out.

M. G. Robinson remarked that the centrifugal compressor was much like centrifugal pumps and that the similar correction factors had to be applied. He had found in the case of a compressor having a blade angle of 20 deg., that the actual angle of air leaving the rotor was 14 deg. 45 min., that with steep blade angles the actual angle was closer to the blade angle, and that a casing with vanes causes less variation between actual angle and blade angle.

A. S. McHugh believed the theory in Lichtenstein's paper to be sound and that good results may be obtained from it.

S. A. Moss remarked that at the point of maximum efficiency the blade angles are right, that no recirculation takes place, and that there is no shock. In determining losses from test curves, the designer is handicapped by absurd losses at high and low discharges.

H. S. Harris in answer to a question by F. W. Dean, gave some interesting high efficiencies that had been obtained on tests.

I. E. Moultrop and M. D. Angle complained that the performance curves of pumps obtained from field tests did not agree with the manufacturers' curves, and that, too frequently, pumps fail to meet efficiency gaurantees. They felt that the pump manufacturers should guarantee the performance of the pump over its full working range instead of at only one point, and that it is up to the manufacturer to maintain equipment and perform tests on all of their products.

These remarks started an interesting discussion in which W. M. White, H. S. Harris and A. G. McHugh gave the manufacturers' side of the question.

In closing, Prof. E. G. Hooper, who had presented H. T. Davey's paper, stated that he had carefully compared the figure questioned by Mr. White, with the original and had found them in agreement, and that the error was not typographical.

J. Lichtenstein stated that the whirl flow in the vanes of the disk was theoretically necessary in order for the pump to operate. Replying to M. G. Robinson's remarks on compressors, he stated it had been his experience that the steeper the blade angle the greater the difference between the actual water angle and the blade angle. In closing, he said a large number of pumps had been calculated by this method with good results.

Joint Session With American Society of Refrigerating Engineers

ON TUESDAY afternoon, December 6, with Willis H. Carrier, president of the A.S.R.E., as chairman, a joint session of the A.S.M.E. and A.S.R.E. was held. This meeting dealt largely with the subject of heat transfer, and some attention was given to the topic of fluid flow.

Heat Transfer by Conduction and Convection

A RATIONAL formula for heat transfer through fluid films was the subject of a paper by Edwin R. Cox, engineer, California Gasoline Company, Los Angeles, Calif. Starting with the work of Osborne Reynolds in 1874, consideration was given to the work of such investigators as Boussinesq, Nusselt, McAdams and Frost, Rice and Soenneken. From this study values of exponents and coefficients were determined to apply in the Boussinesq-Rice formula, which the author considered the best available expression of the film concept of heat transfer. A further step led to the development of a series of equations for application in designing heat transfer apparatus for liquids such as oil and water and for gases. Finally, the paper showed how these formulas could be used for determining the most economical size of tube for a given purpose.

A discussion brought out the fact that peculiar merit attaches to Cox's work as given in this paper, for two reasons: First, because it has made Rice's work more

available in practice by converting it from C. G. S. units to ordinary units; and second, because heretofore investigators have paid but little attention to the effect of viscosity on heat transfer.

Transmission Through Walls

THE transmission of heat through walls and roofs of various types of construction formed the subject of a paper given by F. G. Hechler, professor of engineering research, Pennsylvania State College. Data from a series of tests were presented with a view to showing that transmittance for a wall may be satisfactorily computed from fundamental constants of conductivity for each material making up the wall, a method that was said to make better allowance for variation in insulating value of materials than do other methods. In the present state of this investigation it was not recommended that constants be set up by the testing of complete wall samples. It was considered better to determine in the laboratory the thermal conductivities of each material in the wall and from these to calculate the transfer for a wall section.

Discussion

Discussion of this paper tended to confirm the author's contention that the time was not ripe for establishing a code for heat transfer through walls. It was pointed out that this study of heat transfer is also applicable to the tank type of feed-water heater, where the velocity is so low that the transfer is in the same class with the transfer through building walls. The effect of sunshine and of moisture on wall transmittance was also discussed, it being brought out that both of these factors disturb conditions for some time after they have passed.

Applied Mechanics Meeting

Measurement of Flow of Air and Gas With Nozzles

MEASUREMENT of the flow of air or other gas is very commonly obtained by the use of measuring nozzles. Sanford A. Moss, Thomson Research Laboratory, General Electric Co., Lynn, Mass., presents in his paper, "Measurement of Flow of Air and Gas with Nozzles," a résumé of the various items involved in a satisfactory set-up for laboratory flow measurement and gives one good way of handling each item.

For general testing purposes there should be used a nozzle with a gradual, well-rounded approach and with a parallel portion of appreciable length. For laboratory test purposes it is deemed advisable not to use an orifice in a thin plate or a sharp-edged orifice.

There are three common types of nozzles—one with a well rounded concave-convex approach, one with a well-rounded convex approach, and one with a tapered approach. These three types of nozzles are illustrated and the method of making pressure connections shown. These arrangements show the use of an impact tube wherever it is possible to substitute it for a static hole because of the uncertainty of the result obtained from a static hole. The author gives some discussion on the methods and precautions necessary in measuring the temperature and pressure of the gas before and after the flow nozzle.

After a discussion of the various physical constants that appear in the theoretical equation for air flow, the author derives a set of six simplified formulas that cover various ranges of pressure ratios. A set of curves is given that show the percentage of difference between the values given by the various formulas and the theoretically exact formulas.

Included in the paper are tables showing the correction factors for mercury columns, constants for reducing inches of water column to pounds per square inch, gravity correction factors and corrections to the air formulas for humidity in the air.

Discussion

In opening the discussion, H. S. Dean, of the Bureau of Standards, related experiences he had had with nozzles for measuring air flow where accuracies of 0.1 per cent were required. He had found that the shape of the nozzle affected the nozzle coefficient and showed curves of the coefficients obtained. He agreed with the author that the thin plate or sharp-edged orifice should not be used for laboratory tests, but said there were more sources of inaccuracies in its use than had been mentioned in the paper. The condition of the edge of the orifice it was claimed, might cause errors of from —1 per cent to +5 per cent.

Prof. A. J. Nicholas stated that a jet contraction takes place after the air leaves the nozzle throat. He called attention to other tests that indicated the nozzle coefficient was not constant and with pressure ratios of 1 to 2.5 the coefficient varied from 0.7 to 0.99. He did not agree with the value of k given in the paper and gave 1.405 as a more correct figure.

M. G. Robins thought the specified length of pipe ahead of the nozzle was excessive. He reported tests using a set-up as given by the paper, in which two nozzles, one 30-in. diameter and one 15-in. diameter, were used simultaneously to measure the same air flow, and that the results obtained from each nozzle agreed to within one per cent.

E. O. Waters inquired regarding the method of locating the impact tube used for measuring the initial, or upstream, pressure.

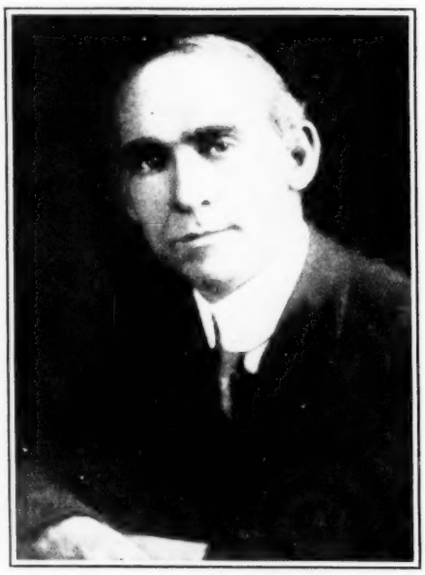
In closing, Mr. Moss stated that for all engineering purposes the coefficient of the nozzle was constant irrespective of the shape of approach curve. He explained that the value of k was given for air containing moisture and CO_2 and not theoretical dry air. The pitot tube for measuring initial total pressure is placed at the point of average velocity as determined from a pipe traverse.

The Relationship Between Industry and Taxation

By Dr. T. S. Adams
Professor of Economics at Yale

AMERICAN industry in the future must look forward to heavier and not lighter tax burdens, T. S. Adams, professor of political economy at Yale University and president of the American Economic Association, declared in the annual Henry Robinson Towne Lecture before the A.S.M.E., Dec. 8.

Professor Adams warned the public to "cherish no illusions about further reduction of expenditures and taxation" for investigation has shown that "since 1921 state and local taxes have increased more rapidly than federal taxes have declined, and it is highly probable that a similar or greater increase will mark the future." Toward taxation industry should take what President Wilson might have called the "handsome attitude," Professor Adams said, adding: "We look to industry for an enlightened selfishness, but American industry has taught us to look for something more than pure selfishness. Prudence plus: such is American industry and such is life. For my part I would not have it otherwise.



T. S. Adams

"President Coolidge and Secretary Mellon have recently criticized the Chamber of Commerce of the United States—thus assuming the traditional rôle of the prudent executive—for demanding a reduction of $400,000,000 in the present tax budget. In my humble opinion, both sides in this discussion depend too much upon estimates and statistics. In any event, the debate itself is a wholesome sign.

"In the eight years 1920-27, the so-called surplus of the Federal Government, as nearly as I can figure, averaged about $340,000,000 a year, and was $635,000,000 in the year 1927. Such surpluses are an open invitation to extravagance and to political tax cuts, by which I mean tax reduction based upon nothing more solid than a desire to win votes. The spender and the politician are awake, with keen eyes and keener appetite, and in the long run the opposition of the taxpayer is an indispensable factor in holding them in check. We touch at this point a subject matter of great intricacy, in which it is not easy to discern the exact path of truth and wisdom. While the so-called annual 'surplus' has averaged $340,000,000 in the eight years 1920-27 inclusive, the average annual debt retirements have exceeded $850,000,000.

"In short, we have 'paid down' the national debt each year by an amount much in excess of the 'surplus.' This excess apparently represents sinking-fund appropriations, payment of principal and interest from our European debtors, and miscellaneous funds available for debt reduction. In the years immediately following the war, large debt retirements were effected by the simple device of reducing the large working balance of the Treasury, which was built up to rather excessive proportions during the war.

"The real problem as I see it, is not one of statistics, but of forces. At least four powerful figures are contending for the control of this large margin or surplus, whatever its exact size may be—the spender, the taxpayer, the politician (wanting unnecessary tax reduction to catch votes), and the saver, represented by President Coolidge, with Secretary Mellon, General Lord, and Congressman Madden in the immediate background. During the last eight years the 'saver' has waged a magnificent battle, and if it were certain that he could continue to win, I should add my counsel to those who are urging the taxpayer to abate the vigor of his fight. But in my deliberate opinion the spender and the politician will, in the next ten or fifteen years, win more victories than the saver. I make no pretense of knowing on abstract or scientific grounds where in this field lies the path of truth and wisdom. But I know that it is not a fight primarily between the taxpayer and the saver. The taxpayer's real antagonists are the politician and the spender. The taxpayer cannot afford to lay down his arms in the belief that what he doesn't get the saver will. The industrial taxpayer must press his claim.

"It is my opinion that in the last five or six years the corporations of the country, through their comparative inactivity, have failed to secure reductions which were fiscally possible and which would have benefited not only themselves but the country as a whole. There has come to be an artificial and unjustifiable discrepancy between taxes imposed, respectively, upon incorporated and unincorporated business enterprises. A few unincorporated businesses pay higher taxes than they would pay if incorporated. But on the average the reverse is true. According to recent estimates of the Treasury Department, if the corporations of the country were treated as partnerships, the average rate of tax on the stockholders would

be 9.10 per cent; whereas they actually pay, through the corporation, 13½ per cent and are subject in addition to surtaxes on distributed dividends which bring the total rate paid through both taxes to 15.27 per cent.

"This discrepancy between the individual and the corporation rates not only represents an illogical discrimination against the corporate form of business organization, but it has other unwholesome effects which cannot be discussed at this time.

"What I wish to emphasize is this: If the corporations had pressed actively for tax reduction in the last five or six years, it is highly probable that the discrimination in question would, to a large extent, have been removed. I insist that during that period some industries obtained tax reduction by insistence and pressure which deserved it less than other industries which actually received harsher treatment. I believe that we should have a sounder and better tax system in every way if we had retained some of the war taxes on semi-luxuries which have been repealed, and refused certain deductions or exemptions within the income tax which have been granted, using the proceeds to reduce the general corporation rate."

"The corporations as a whole permitted certain limited interests to obtain exemptions and reductions when the general body of corporations, in my opinion, had a better and sounder claim for a reduction."

The congestion in the Bureau of Internal Revenue was called by Professor Adams "a standing indictment against our political intelligence and our capacity for efficient administration." This situation, he asserted, presents a challenge to the industrial and business interests.

Crowded Docket Worst Feature

"The worst side of the picture, however, is still to come," he continued. "On June 30, 1927, there were pending before the Board of Tax Appeals—the primary board of review and appeal in federal income and estate tax cases—18,313 undecided appeals, involving alleged additional taxes due of $542,000,000. It has been estimated that the Board would be required to devote approximately four years, 'if no other cases were presented to it, to clear its docket.'

"The interest of the various industries in tax-making are in partial conflict. In the past the farmers were, I believe, opposed to the repeal of the excess-profits tax; and organizations which appear fairly to represent the agricultural interests are now opposing the reduction of the corporation rate. The Treasury Department, acting in behalf of a well-founded tax system, opposes the demand of the automobile manufacturers and proprietors of amusement enterprises for reduction of the excise taxes on automobiles and amusements. Conflict is of the essence of the tax problem, and certain aspects of this conflict are worthy of further note. If industry generally, through good-natured complacency, remains silent when a special industry is asking for something it should not have, it will in the long run not only suffer by the exemption, but it will lose its influence in the legislative bodies which make and unmake taxes. If industry in general at the present time shares Secretary Mellon's belief that we should keep the taxes on automobiles and amusements as a desirable supplement to the direct taxes —for the same reason that we keep the tax on tobacco— industry in some way should give voice to this opinion.

"There is inordinate delay in the final settlement of the larger and more involved tax cases. This problem is created largely by the legalistic idolatry of the American mind. The principal evil of delay is found in the uncertainty and apprehension which it inflicts upon taxpayers. It constitutes one of the major evils which now beset American business. In addition, it is very costly to the Treasury." The Treasury has lost hundreds of millions in the last four or five years through changes in rulings, Professor Adams charged. The problem of delay, he thought, could be solved with two or three simple measures if a real will to solve it were created. "We are blinded at present by traditional but outworn methods of procedure," he pointed out. "The remedy lies in applying a few simple changes that the business man or the engineer would recognize after even superficial study.

"Much of the delay and uncertainty which characterizes the administration of the income tax is traceable to the constant change of personnel in the Bureau of Internal Revenue. In the highly important legal department of the Bureau, now called the Office of the General Counsel, there have been nine successive heads since the outbreak of the war. There are only eleven attorneys who have served in this department for more than six years, and 52 attorneys have resigned from the department since July, 1924. In the Income Tax Unit there have been 4,727 resignations of professional and technical officials during the last seven years. A. W. Gregg, the brilliant young attorney whose work in Washington has attracted widespread attention, recently resigned as General Counsel after serving in that capacity for less than three years.

"It is rumored in Washington that C. R. Nash, generally recognized as the ablest administrator the Bureau of Internal Revenue has ever known, has handed in his resignation. In England his tenure of office would have been permanent during good behavior; he would have been given a salary equivalent to $15,000 or $18,000 a year in this country, with the assurance of a substantial pension on retirement; he would probably have been knighted, and he would have stayed in the government's service.

Hope in Business Men and Engineers

"Simplification of the income tax is an entirely different matter. Whether the income tax will ever be simplified is highly doubtful. Congress has tried it and failed. The tax experts have worked at it long and assiduously, but have concluded that it is impossible.

"What the statesman and the tax expert have failed to do, perhaps the business man and the engineer can accomplish. The quest for simplification must go on. Where it will lead eventually, no one can tell. For certain classes of taxpayers I feel confident that a simple law can be devised. For the others, if we cannot achieve simplicity, we may at least obtain comparative certainty. In the end a solution may possibly be found in some simpler and better substitute for the net income tax.

"It is both inevitable and proper that the various industries of the country should endeavor actively to influence the form and burden of the taxes imposed upon them. The most important task and opportunity of American industry in the field of taxation is to work vigorously, through a specialized organization representing all branches of industry, for the clarification of tax laws and the improvement of their administration."

What National Engineering Societies Can Do for Engineering Education

By W. E. WICKENDEN
Director of Investigation, Society for Promotion of Engineering Education, New York, N. Y.

A program looking to the future higher professional standards through more active guidance of educational activities

TUESDAY afternoon, at 4:30, Mr. Wickenden addressed a large and enthusiastically interested audience on this important question, and his proposals made a decided impression on his hearers.

Engineering education today is essentially sound and is sufficiently flexible to adapt itself to the ever-changing needs of the hour, but it has failed to make itself interesting to the general public to the degree that has been accomplished in other professional fields.

The national societies of Europe have an interesting history in this connection. Both the British Institution of Civil (that is, civilian) Engineers and the Verein Deutscher Ingenieure were started expressly for the purpose of assisting younger men to secure technical training and education for engineering activity. To some extent they shared the nature of educational institutions and student fraternities.

The professional standing of the engineering profession rests on selective processes conducted in the colleges and preparatory schools, practically without guidance from the profession itself. Engineering as a profession suffers both from the tin halo of popular literature and the movies and from the lack of public appreciation of the real fundamental importance of engineering activities.

W. E. Wickenden

The Society for the Promotion of Engineering Education has conducted extensive studies to determine the views of professional engineers on questions of engineering education.

It has become evident that the general opinion is that academic education is highly desirable, but that experience is indispensable for the mastery of engineering proficiency. No single program suffices for all cases, and the range of training necessary ranges from the purely vocational to the highly professional level.

It seems to be the consensus of opinion that formal teaching prior to the development of experience should be limited to fundamentals. Specialization should be deferred until after graduation, either in the graduate school or in active practice.

It is emphasized that teachers in engineering schools require thorough scholarly preparation, significant engineering experience and active touch with current practice.

The engineering societies are at present faced with an issue of the greatest moment. Should the engineering profession, through its national societies, exercise more active influence on education? So far, American engineering education has been controlled by professional educators. There has been little fostering or guiding of schools by the profession itself. There has been no protection for schools maintaining high standards and no pressure toward high standards on schools that fail to maintain them. It is true that this policy of *laissez faire* has spared education the evils of arbitrary standardization, but it has cost the loss of much that would be good.

Mr. Wickenden proceeded with a detailed study of how to extend the influence of the profession on education and presented the findings of the questionnaire. He proposed the pooling of interests by the national societies and the Society for the Promotion of Engineering Education, through the organization of a joint committee to guide the establishment of engineering standards.

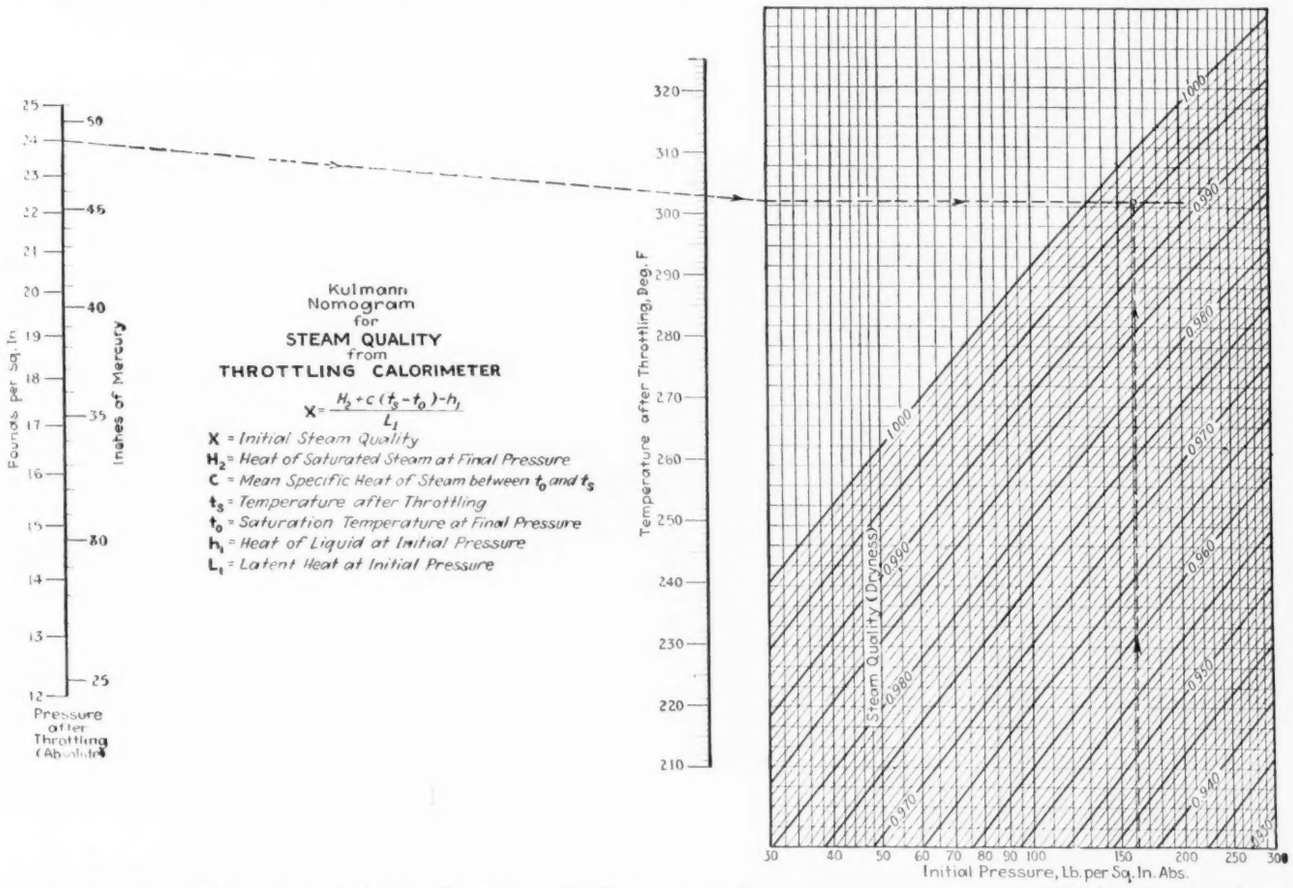
The present rules for admission to national engineering societies are based on the original conception of a profession open to all who wish to enter it. These rules require codification and revision, in view of the changing status of the engineer today.

It was pointed out that the student branches provide an important channel of influence between the societies and the undergraduates. Each student branch should have at least one lecture per year by a prominent engineer, presenting to the student the history, traditions, ethics and social functions of the engineering profession.

Chart Gives Steam Quality From Calorimeter Readings*

By C. A. Kulmann
Consulting Engineer

IN THE throttling calorimeter the wet steam is throttled from the high pressure at which it is wet to a lower pressure at which the same amount of heat makes the steam superheated. Since the amount of heat lost in throttling is slight, an equation can be written between the amounts of heat before and after throttling. This reduces to the form shown on the accompanying nomogram. The quantities appearing in this formula are


Kulmann
Nomogram
for
STEAM QUALITY
from
THROTTLING CALORIMETER
$X = \frac{H_2 + C(t_s - t_0) - h_1}{L_1}$
X = Initial Steam Quality
H_2 = Heat of Saturated Steam at Final Pressure
C = Mean Specific Heat of Steam between t_0 and t_s
t_s = Temperature after Throttling
t_0 = Saturation Temperature at Final Pressure
h_1 = Heat of Liquid at Initial Pressure
L_1 = Latent Heat at Initial Pressure
Pounds per Sq. In.
Inches of Mercury
Pressure after Throttling (Absolute)
Temperature after Throttling, Deg. F
Steam Quality (Dryness)
Initial Pressure, Lb. per Sq. In. Abs.

consisting of three lines, one of which (on the left) is scaled with the pressure after throttling. Another is scaled with values for actual temperature after throttling.

To use this chart, proceed as follows: Starting at left, draw a straight line (or carry straight-edge) from the "pressure after throttling" through the "temperature after throttling" to the left edge of the graph. Then move horizontally to the intersection with the vertical line corresponding to the initial pressure. Read the initial quality at this intersection.

For example, assume an absolute back pressure of 24 lb., a temperature of 303 deg. after throttling, and an initial pressure of 162 lb. abs. The solution is shown by the dotted line. Stretch a straight-edge (or draw a straight line) from 24 lb. on the left scale through 303 lb. on the center scale to the vertical line forming the left edge of the graph. From this move horizontally to the intersection with the vertical dotted line corresponding to 162 lb. initial pressure. The intersection lies on the sloping line for 0.996 dryness.

rather large and the range of the result so narrow that slide-rule work is too inaccurate and actual computation is a long process. Both of these difficulties are obviated by the use of the chart, which is more accurate than the ordinary slide rule and at the same time far quicker than computation.

The chart is in two sections. The graph portion, at the right, represents the quantity of heat in a pound of steam at various values of pressure and quality, the heat content being indicated by ordinates on the graph.

The other part of the nomogram is an alignment chart

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Sixth Power Exposition Shows Many Innovations in Power Equipment

THE Power Show to the casual visitor was a comprehensive collection of things mechanical and electrical, of ball and roller bearing equipment, of wheels and gears and belts, of indicating and recording instruments, of heavy forged drums, of pressed metal radiators and heaters, and everywhere strange things of a mechanical age to wonder at. The casual visitor came and saw. Then he left and promptly forgot all about it.

But the trained power executives who also visited the exhibits, questioning, taking notes, asking prices and deliveries, will not forget. There will be many an industrial plant brought up to date, put on a comparable basis with the efficient central station as a direct result of the questions asked and the notes made at the Power Show.

These power executives—the chief engineers, the superintendents of equipment, the plant engineers, the power consultants—did not look at the exhibits as unrelated units. Rather they viewed them as interrelated steps in their programs for 1928 to generate, distribute and apply power for their own use efficiently.

The foresighted men (among these technical show visitors) and their managements are losing no opportunity for this coming year to meet the imperative demand for more production per unit of factory, for less cost per unit of product turned out.

The central station can produce a kilowatt-hour of power on one square foot or less of boiler-heating surface. The Power Show had on exhibition everything necessary for the small industrial power house to do fully as well.

There are the primarily essential instruments and measuring devices to fit every requirement for checking existing performance in order to determine the necessary modernizing steps.

There is equipment for steam and electric generation that is available in self-contained units extending from coal pile to power delivery line. This equipment is available in sizes that will fit even the modest plant.

There is equipment for picking up the delivered power, whether it is steam for plant heat, for process work, for drive in the plant, or electricity for the same purpose, for compressed air, for hydraulic pressure, for all the plant services that come under the jurisdiction of the power executive.

There is equipment and apparatus for applying these power services, both in the power house and in the industry.

And finally, but by no means of least importance, are the tools and supplies for operation and maintenance, the lubricants, the packing, the insulation, the refractories, the boiler water treatment and steam purifiers, winches and hoists.

The Power Show of 1927 or, better, the Power Show for 1928 points clearly what the power equipment

manufacturer has done to make possible the inevitable movement to put the industrial power house in its true position as a useful, necessary and economical production unit in the industrial manufacturing or service plant.

Viewing the exposition as a whole, it could be termed an outstanding success, and thoroughly representative of the equipment necessary to the economical generation and utilization of power. It was clearly evident that the manufacturers are attempting to make their exhibits more attractive and educational, from year to year, rather than to increase the size. As a matter of fact, many of them showed less equipment than in previous years, but it was more attractively arranged and represented the most improved types of apparatus he had to offer.

In view of the size to which the show has grown, with a total of 530 exhibits, it is impossible within practical space limitations to describe each exhibit in detail. Some of the important exhibits and illustrations of new equipment to be found at the show were mentioned in the November 29 issue, and further mention is made here of the outstanding exhibits and to those which include new equipment and developments recently introduced into the field.

Although there has been extensive increase in the use of pulverized coal during the last few years, there was a bigger showing of stokers at this year's show than at any previous one, and in most cases commercial sized units of the most improved types were shown.

Outstanding among these were the McClave-Brooks forced-draft chain-grate stoker for all grades of anthracite coke breeze and mixtures. The stoker is equipped with three-speed spur-gear drive, forced-draft air dampers for each compartment or zone controlled independently from the front of the stoker and with siftings remover chains in each air compartment. An important feature of the stoker is the design of link used, which permits replacement of individual links without turning or removing the grate link rods in any way. Round rods only are used in the stoker, and the links can even be changed while the stoker is under load. The unit shown was the size suitable for installation under a 2,500-sq.ft. boiler.

The Riley Stoker Corporation showed a two-retort superstoker equipped with a new-type turbine stoker drive. Recent improvements made in this stoker include increased tuyere area and air zone control for the grate block section, five zones being used over the stoker length. Provision has also been made for the controlled admission of air above the coal entrance at the front of the stoker. The improved Riley Atrita unit pulverizer was also shown. The recent improvements made to this unit mill include the use of unit casting on the revolving element in place of pegs and the adoption of the totally inclosed magnet on the magnetic separator.

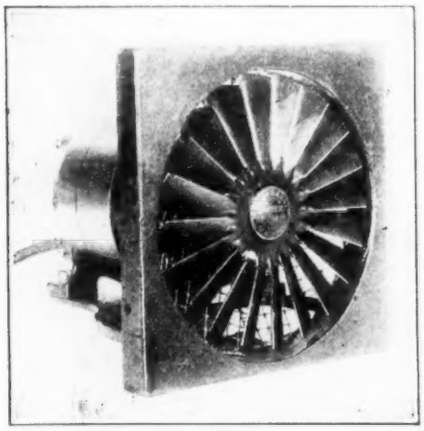
A combined screw conveyor and paddle feeder for discharging refuse into a boiler furnace in a continuous and uniform stream was exhibited by the M. A. Hofft Company in connection with its hand stoker. This combined unit was described in the Dec. 6 issue.

Another stoker recently introduced into the field is the Thacher shown by the Builders Iron & Steel Company, of Everett, Mass. This is an overfeed stoker in which an alternating portion of the stoker bars is always in motion while the remaining bars are at rest. The stoker is designed for use with practically any type of boiler in sizes from 1,500 to 5,000 sq.ft. of heating surface. The latest developments in stokers were also shown by the Detroit Stoker Com-

View of the main floor from the mezzanine

pany, the Flynn & Emerich Company and the Master Engineering Corp.

In the field of forced- and induced-draft equipment innovations in design were shown by the B. F. Sturtevant Company. With a view to increasing the over-all efficiency,



De Bothezat forced-draft disk fan

decreasing the power required by the fan, especially at light loads, this company has recently introduced a forced- and induced-draft fan of the double-inlet type, having adjustable vanes at the air inlet to control the pressure and volume of air delivered over the complete operating range, without changing the speed. Further description of these fans will appear in a later issue.

In addition to draft equipment the Green Fuel Economizer Company had a model of the new cinder trap in operation. This unit was described in the Nov. 15 issue. This company also showed its standard tubular air heater and a new type plate heater of welded construction.

The Buffalo Forge Company has redesigned its volume fan so that the purchaser need only specify the size of fan required. The type of discharge, whether top, side or bottom, can be adjusted in the field to eight different positions as conditions require. Also a right-hand fan can be changed to a left-hand fan.

A small forced-draft fan of the disk type, designed to supply air under one inch static pressure, was included in the exhibit of fans for various uses by the DeBothezat Impeller Company, Inc.

Included in the exhibit of the Babcock & Wilcox Company was a section of the return-bend steel-tube economizer (described Aug. 30, 1927), also a forged steel header for 1,400 lb. pressure and a section of a Stirling boiler drum showing the method of construction now employed for high pressure.

The Walsh-Weidner Boiler Company also showed a section of its boiler drum in which the construction is a departure from the conventional practice. The boiler drum heads are put on the outside of boiler drum sheet instead of on the inside. The joint has machined surfaces and this construction puts the double butt and welded seams at the end of the drum under compression instead of tension. A forged-steel header for 1,600 lb. and a high-pressure water gage for pressure from 400 to 1,600 lb. was also shown.

A radical departure on boiler construction was also featured by the Edge Moor Iron Company. Here a full-sized hammer-welded boiler drum which this company is now using in its single-pass boilers, was shown. The drum was made from $1\frac{1}{4}$-in. plate, $36\frac{1}{2}$ in. in diameter and 6 ft. 3 in. in length. In addition to welding the longitudinal seams both drum heads and connections for the nozzles are welded to the drum.

The Wickes Boiler Company showed photographs of its new hydraulic press for forming heavy shell plate in one piece instead of by rolling. A model of its three-drum curved-tube boiler arranged for pulverized coal firing was also shown.

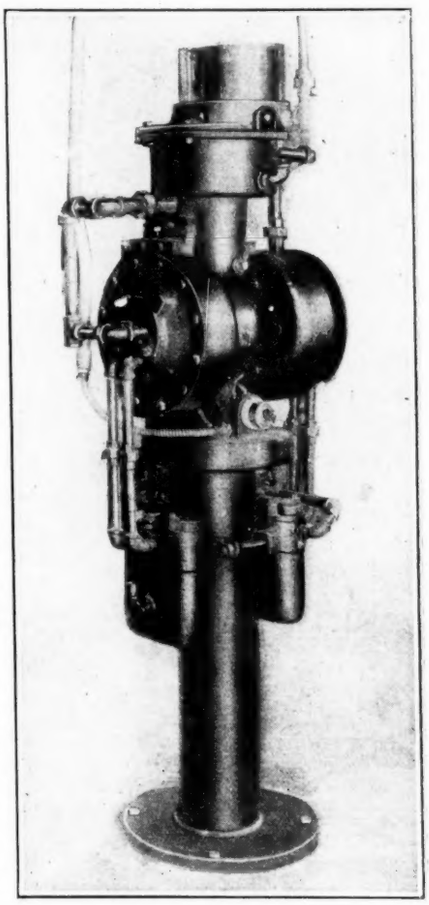
A small section of forged-steel drum as used in Ladd boilers designed for 1,400 lb. was shown by the Combustion Engineering Corporation. The walls of the drum are made of forged steel $5\frac{1}{4}$ in. thick, and the section showed the constructural features.

The improved type of distributing header for its film-evaporation type boiler was shown by the La Mont Corporation; also, enlarged drawing of how a section of the boiler, or, rather, a tube tray is applied to a horizontal return-tubular boiler in an industrial power plant. A description of this unique installation appeared in the Nov. 22 issue of *Power*.

A complete model of a three-drum bent-tube boiler equipped with integral economizer and a recent design of the Seymour basket type furnace with unit type pulverizer and burner was a feature of the Erie City Iron Works exhibit.

The Bailey Meter Company, in addition to displaying a line of boiler metering equipment, showed an improved type of power drive for its meter-control system of automatic combustion regulation. In the old type of power drive the fuel and air adjustment was combined in the one machine; with the improved type a separate machine is used for each function. The single unit is simplified mechanically and can be located in the most convenient place with relation to the fuel-feed or air-flow device to be controlled.

At the Hagan Corporation booth was shown an extensive line of automatic-combustion control apparatus. On one of the systems the initial impulse for an increase or a decrease in the combustion rate is set up in a master regulator by a change in steam pressure. This demand for a change



Smoot gas density regulator

in the fuel feed and air flow is transmitted to the fuel and draft regulators on the individual boiler by low-pressure air. On another system, the master and the air-flow and fuel-feed regulators are connected electrically. A change of steam pressure causes the master regulator to function and close contacts that energize a motor on the individual boiler regulators that adjust the air flow and

fuel feed to the new demand for steam.

A model showing a method of cross-baffling on inclined-tube boilers, to increase the area of available heating surface, was exhibited by The Engineer Company along with its line

Some of the exhibits along one of the outer aisles

of combustion control equipment. This type of baffling also tends to reduce the abruptness of the turns that the gases of combustion make in passing through the boiler, thus improving the draft conditions. A new combination gas and oil burner was shown for use in oil refineries that will burn stripped still gas, refuse oil, natural gas or fuel oil.

A full-sized working model of a new type turbine valve was demonstrated by the Smoot Engineering Corporation. This valve is built for high-pressure superheated steam. The throat of the valve is shaped like a steam-turbine nozzle, but with a regulated area, and the point of highest steam velocity is away from the seating surfaces. This stream-line flow eliminates the tendency of the steam to cut the valve seat. Operation of the valve is provided for by a hydraulic cylinder mounted on the valve yoke, and control is made automatic by a regulator. This company also demonstrated a new flue-gas density regulator (see illustration) as part of a working model of its automatic system of boiler control. This machine is applied to combustion-efficiency control by functioning to proportion the relative quantities of fuel and air to maintain a fixed density of flue gas.

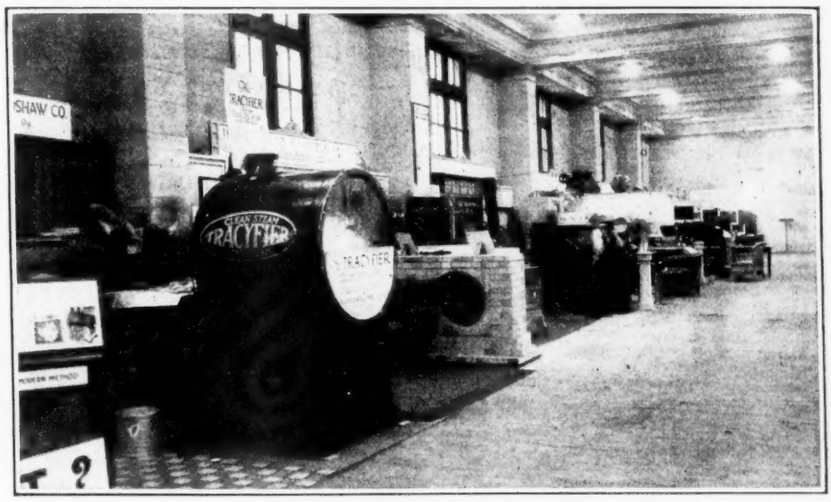
One of the features of the General Electric exhibit was the new atomic-hydrogen equipment. In this method of welding, a jet of hydrogen is blown through an electric arc between two tungsten electrodes, changing part of the hydrogen from the molecular to the atomic form. That is, the two atoms of which each hydrogen molecule is composed are separated by the intense heat of the arc. In this separation the atoms absorb energy from the arc. At a certain distance from the arc the atoms unite again to form molecules. The energy released in this action produces an intensely hot hydrogen flame suitable for welding.

Another feature of this exhibit was a number of selsyn applications to power-plant signal systems. The selsyns consist of a single-phase shuttle-wound rotor with a three-phase stator. One of the units is placed in the transmitter and one in the receiver, the two being connected in parallel, with the rotors connected to a source of single-phase power. When the rotor of the sending unit is moved to a given position, the rotor of the receiver will move to a corresponding position. This device can be used not only for a wide variety of signaling applications, but also for automatic control and recording purposes.

Instrument and control equipment stands were exhibited, which were designed for the purpose of replacing several miscellaneous lines of pedestals and self-supporting panels used on power-plant floors for mounting switches, instruments and control equipment.

The Cutter Electrical Manufacturing Company had on exhibition a three-pole solenoid-operated air-break circuit breaker designed for 6,000 amperes alternating current on 8,000 amperes direct current and 440 volts. A semi-automatic transfer circuit breaker was also shown, which, in case of power failure on one set of busbars, will automatically transfer the load to another power source. Another feature was the picture of a recently completed breaker rated at 45,000 amperes and 525 volts, direct current.

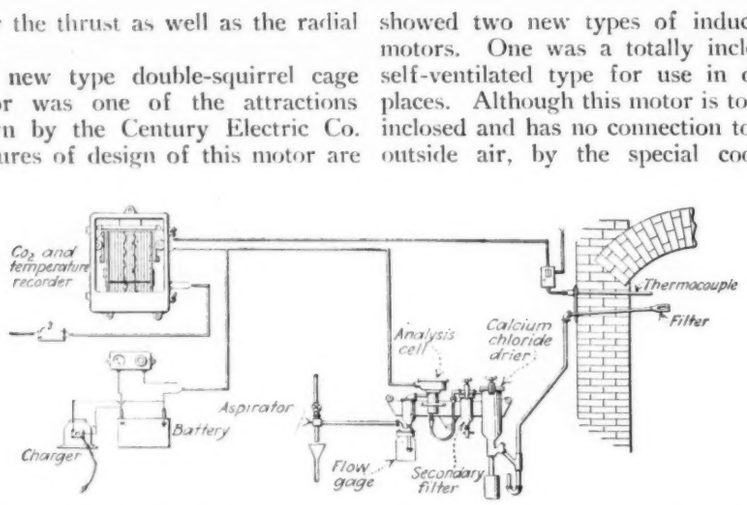
An interesting development exhibited by the Allis-Chalmers Company was a centrifugal pumping unit in which the pump was supported on an extension to the motor's bearing bracket. The pump impeller is mounted on an extension of the motor's shaft and the motor's bearings serve to carry the entire rotating element. These bearings are of the tapered roller type and are designed to



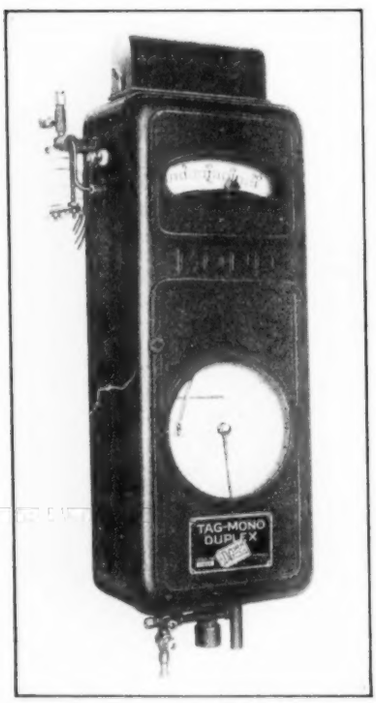
Looking down one of the aisles on the main floor

carry the thrust as well as the radial load.

A new type double-squirrel cage motor was one of the attractions shown by the Century Electric Co. Features of design of this motor are entirely closed slots for the high-resistance rotor winding, and one-half the number of bars in the low-resistance that there are in the high-resistance winding. One type of these motors will give 25 per cent greater starting torque than the standard squirrel-cage motor and the other a starting torque equal to the standard motor, but with 20 per cent less current.



Engelhard stack meter for recording the CO_2 and flue gas temperature on one chart



Tagliabue improved "Mono" CO and CO_2 indicating and recording instrument

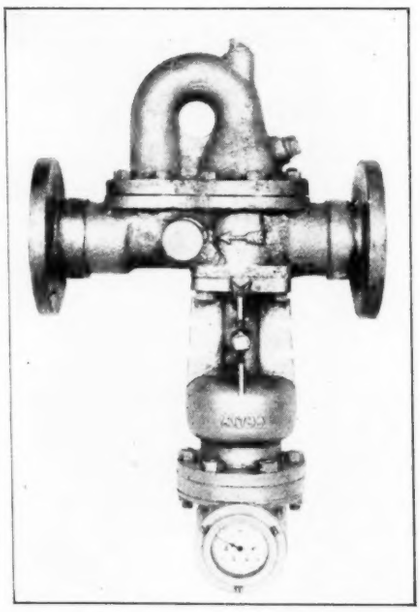
Fairbanks-Morse & Company showed two new types of induction motors. One was a totally inclosed self-ventilated type for use in dirty places. Although this motor is totally inclosed and has no connection to the outside air, by the special cooling feature outside the motor it has practically the same dimension as the standard open-type machine. The other motor was a double-squirrel cage machine in which the low-resistance winding is short-circuited magnetically during the first part of the starting period. When the motor approaches full speed, the magnetic short-circuit about the low-resistance winding is opened. Another feature of this exhibit was a screw pump that will pass through the impeller anything that can come in through the suction.

The Cutler-Hammer Manufacturing Company exhibited among its line of motor-controlled equipment, a small across-the-line automatic starter. This starter is totally inclosed, is started and stopped by push buttons that extend through the case, and is equipped with thermal overload relays. Another new type of control shown comprised push-button operated reversing contactors. These contactors were mounted on opposite sides of a panel so that they occupied the minimum of space and were mechanically interlocked to prevent both being close at the same time.

Among the products shown by the Lincoln Electric Company was a new push-button reactor-type starter for squirrel-cage motor. The reactor has an adjustable core, so that it can be adjusted to start motors in sizes from $7\frac{1}{2}$ to 25 hp. The starter is equipped with a time delay that will not allow the reactor to be short-circuited until the motor current has dropped to a predetermined value.

A small static condenser for power-factor correction was shown by the Electric Machinery Manufacturing Company, which is intended for use on individual induction motors. In this equipment the condenser elements are made in the form of small rolls. Each individual roll is a complete condenser made of interleaving layers of tinfoil and tissue paper. These condenser rolls are assembled in standard units and immersed in a tank of oil. Operation of the condenser cannot be interrupted by injury to a single roll. These units are made in sizes down to $\frac{1}{2}$ kva. at 550 volts. This company had in operation a synchronous motor to demonstrate its frequency-relay type of automatic control.

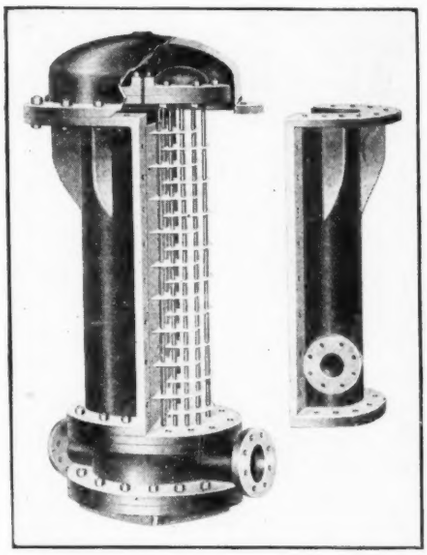
Among the interesting features at the Westinghouse Electric & Manufacturing Company's exhibit was a new 3-kw. turbine-driven 125-volt direct-current generator, for use where a small steam non-condensing lighting unit is required (see page 899 Dec. 6 issue). The unit is of compact design, with the turbine cylinder bolted to a frame on the generator, but the turbine and generator are completely isolated from each other to prevent steam or water entering the generator. A new turbine-driven gear-box for multiple-retort underfeed stokers was another feature of this exhibit. This is essentially a small turbine stoker drive, built integral with, and forming part of, a standard stoker gear-box. Its development is intended to fill a demand for



Shunt meter of the Builders Iron Foundry Company

a stoker drive of wide-speed range, capable of maintaining a constant speed when set at a predetermined point. The turbine is totally inclosed and is made dustproof to operate under the conditions existing around stokers.

An improved design of a Mono CO and CO_2 indicator and recorder (see illustration) was exhibited at the C. J. Tagliabue Manufacturing Company's booth. In this new type the



Split-shell heat exchanger of the O. E. Frank Heater and Engineering Company

indicator and recorder are combined into the one case. All the parts of the older types of instruments that were made of glass have been replaced with metal. Another feature of this exhibit was a temperature-regulated reducing valve. A thermometer element is placed in the substance the temperature of which is to be controlled, and this thermometer acts on a pilot valve, which in turn regulates the position of the reducing valve to supply the necessary steam to maintain the temperature constant in the process.

Along with its standard line of indicating and recording gages and thermometers, the Bristol Company showed a temperature indicator for Diesel engines. A temperature element is placed in the exhaust of each cylinder, and these are connected to a switch, which in turn is used to connect the temperature elements to the indicator. This provides a means of determining how each cylinder of an engine is operating.

At the Foxboro Company booth, in addition to the standard line of metering equipment for power and industrial purposes, a new integrator for a steam-flow meter was demonstrated. In the development of this new integrator new calibration coefficients have been worked out.

The Uehling Instrument Company exhibited a new electrically operated CO_2 recorder and indicator. With this type of equipment all steam lines to the meter have been eliminated and the water column to maintain a 48-in. head on the regulator has been replaced by an oil column. The latter allows dispensing with all water and drain lines that were necessary for the older type of meter.

Featured at the booth of the American Schaeffer & Budenberg Corporation was a sectionalized gage board, which is designed to be extended by adding new sections as the size of a plant increases. A new type of precision barometer with electric zero adjustment, to correct vacuum gages to the barometer was another feature of this exhibit.

Exhibited by Charles Engelhard, Inc., was a stack meter (illustrated) which recorded the CO_2 and flue-gas temperatures on the same chart. This meter operates on the well-known Wheatstone bridge principle. For CO_2 reading it is connected into the stack through a gas analyzer and for temperature readings a chromel alumel thermocouple is used.

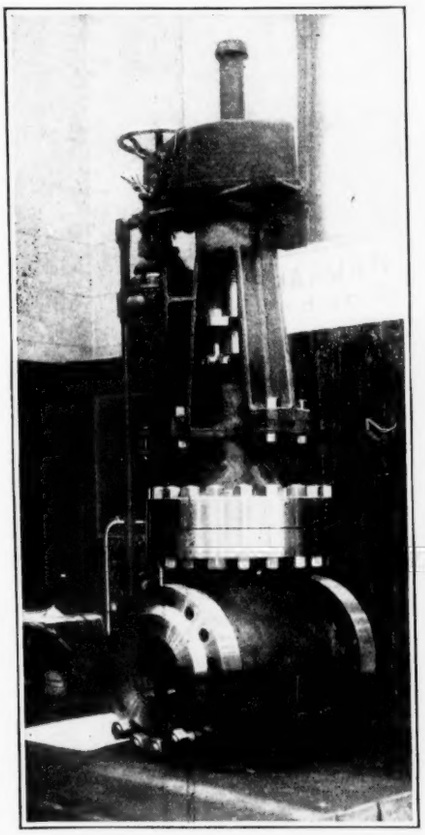
In the Leeds & Northrup Company's exhibit of combustion-control and recording equipment, was a new long-distance load recorder and totalizer. In each station the recording totalizing wattmeter is connected mechanically to a potentiometer, which is connected through a pair of telephone wires to the distant recorder, that may be located in the load-dispatcher's office. One distant recorder is used for each station, and these may be connected to a recorder that will totalize the system load.

In addition to a complete line of single and multi-tube inclined and vertical draft gages Lewis M. Ellison shows a new line of straight-line gages of exceptionally substantial construction. The gages are fitted with an unusually large operating bell, and the knife edges are hardened steel. A panel containing a number of these gages arranged for indicating the various drafts on a stoker installation, as well as a new line of swinging pointer gages of simple construction were also shown.

Among the numerous devices exhibited by Chas. Cory & Sons, Inc., was a disconnect interlock designed for heavy duty, where the switching stress is 7,500 to 20,000 inch-pounds. This interlock was designed to safeguard each step in switching operations. A new type of lock for switch compartment doors was also shown and demonstrated.

A new solenoid-operated piston valve was exhibited by the Ruggles-Klingermann Manufacturing Company. This valve can be arranged to be held open by the solenoid and closed automatically in case the power fails. The electrical operation can also be combined with a hydraulic cylinder and the valve's position controlled from a push button. Another arrangement is to control two or more valves from a master timing switch.

Another feature of this exhibit was a bypass or a regulating valve. This

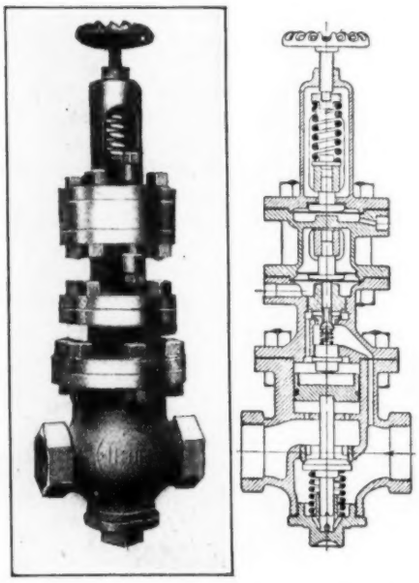


Chapman 14-in. motor-operated chrome nickel steel valve for 1,350 lb.

bypass is arranged so that when the regulating valve approaches the full-open position the bypass is opened and when the regulating valve is nearly closed the bypass will close. The arrangement extends the range of con-

trol of the regulating valve. Hand adjustment of the orifice is provided on both the regulating and the bypass valves.

A long-distance recording thermometer was featured at the booth of the Taylor Instrument Company. It consists of a transmitter that connects to the thermometer element, and a receiving unit. The two are connected electrically so that any change in the position of the pointer on the transmitter will cause a similar change in position in the pointer on the receiving unit. Records of temperature with this device are being transmitted over one mile in commercial practice.

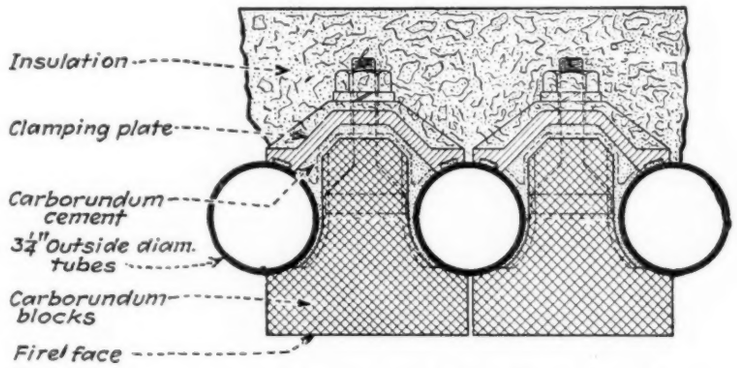


Leslie governor for fuel oil and feed-water pumps

An improved type of electric speed indicator was demonstrated by the Weston Electrical Instrument Company, which is unaffected by temperature and length of leads. These characteristics are obtained by using a comparatively high voltage, 6 volts per 1,000 r.p.m., and a sensitive instrument having 500 ohms per volt.

The shunt steam meter, shown in the figure, was featured at the booth of the Builders Iron Foundry. This is a mechanical type of meter for measuring steam on small lines. The meter is small and can be placed directly in the pipe line and the total pounds of steam obtained on a counter dial of the usual type. Operation is obtained by shunting a part of the steam through nozzles, to rotate a small turbine or the upper end of a vertical shaft. This eliminates any moving parts in the steam line. The counter train at the lower part of the meter is driven from the turbine by a permanent magnet, thus making it possible to seal the gear train completely from the meter body.

At the Paul B. Huyette Company, Inc., booth was featured the new different parts in the meter. Another feature was that of standard equipment arranged so that it could be actuated by hand to create in effect various pressure differential and demonstrate the induction principle on which the flow meter operates.

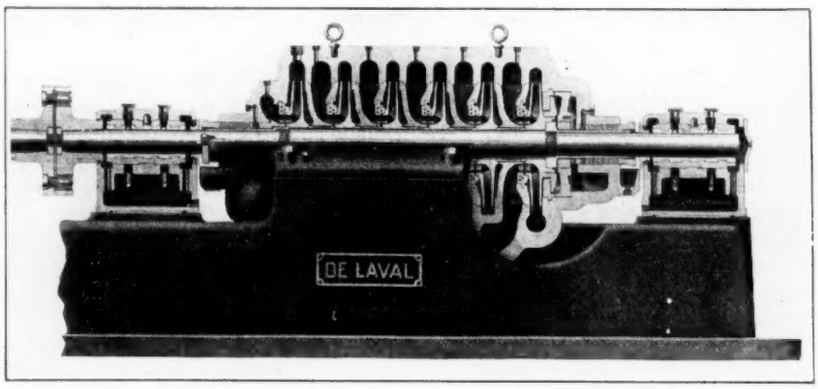


Thayer type water-cooled furnace wall shown by Bernitz Furnace Appliance Co.

Hays Automatic CO_2 and draft recorder. One of the features of the new equipment is a motor-driven pump to supply water to the aspirator. This makes the unit self-contained and independent of the water supply. Where the local water supply is not suitable, water is obtained and put in the machine and recirculated with the pump.

A full-sized working model of its Venturi meter recorder and integrater was shown by the Simplex Valve & Meter Company. This model was in sections to show how all the parts in the meter function.

A new type boiler-meter panel was a feature of the Republic Flow Meter Company's exhibit. This panel included a multiple recorder which will record six individual records simultaneously on one strip chart. In connection with this panel was a large animated cross-section view of a modern-type boiler showing meter connections and points where readings are taken. This was designed to show the relationship between various boiler records and their necessity for efficient boiler operation.



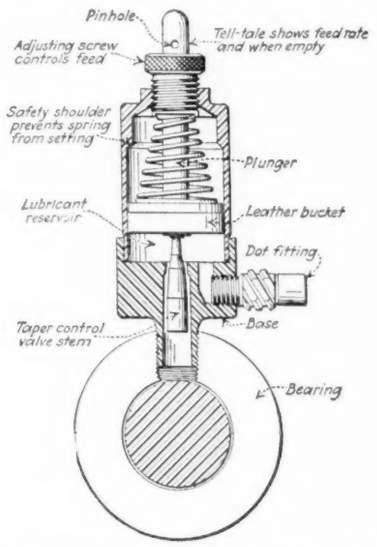
De Laval six-stage pump for high-pressure boiler feeding

An interesting exhibit at the Brown Instrument Company booth was a large illuminated model of the company's steam flow meter, to show the functioning of the meter, from the flow of steam through the orifice in the pipe line to the movement of the

S. F. Bowser & Company, Inc., exhibited a new fluid meter, which is available in sizes from 5 to 12,000 gal. per hour. Inside the meter are five cylinders each fitted with a piston, the lower ends of which are fixed to a wobble plate. As the liquid flows into part of the cylinders, that in the others is being discharged

through a rotary valve. The pressure causes the wobble plate to operate, which in turn operates the recording mechanism.

In the field of heat exchange equipment was a split-shell heat exchanger and oil cooler (illustrated) exhibited by the O. E. Frank Heater and Engineering Company. The split-shell design gives ready access to all the



Dot grease cup for continuous feeding

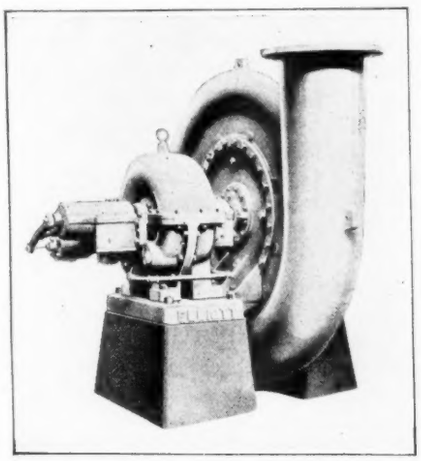
tube nest without removing the bundle. The cooler is fitted with a floating head in two sections and has exceptionally tight fitting baffles. This company also announced a new type of two-pass cooler in which the tube bundle can be withdrawn without breaking any joints on the water lines or disturbing the opposite end of the cooler .

A "Tubeflo" liquid to liquid heat exchanger for use with heavy oil coal tars and other corrosive liquids was shown by the Griscom-Russell Company. The exchanger consists of a single casting with tubes cast into it (see illustration). By removing covers at each end, any scale or deposit is readily reached as it is all on the inside of the tubes. This company also showed a "Bentube" section of an atmospheric cooling unit for use on Diesel engine circulating water and lubricating oil where bad water conditions are encountered.

In addition to the multi-stage high-pressure feed pump referred to in the report of the Show in the Nov. 29 issue, was a large-capacity feed pump, 2,000 g.p.m. for 550 lb., shown by the Ingersoll-Rand Company. Another unit shown for the first time by this company was a multi-jet two-stage steam-jet air pump with inter-condenser.

Outstanding among the exhibits of the valve for high pressures was a 14-in. all chrome steel valve for 1,350 lb. pressure and 1,000 deg. total temperature, shown by the Chapman Valve Company. The valve is stainless-steel trimmed and equipped with the latest type of Chapman control.

A new departure in valves was a 10-in. parallel slide valve for 400 lb. pressure in the pneumatic and electrically operated types exhibited by the M. W. Kellogg Company. The valve is bonnetless and is fitted with a handhole on the side of the body through which the disk and operating mechanism is assembled and the regrinding of the seat can be done. The



Elliott high-speed turbine-driven blower

valve is of the non-jamming type, the disks being flexibly suspended on the stem and seated by steam pressure only. A new design of valve body for the swing-gate type of valve now made by this company was also included. The body is swedged from a extra-heavy seamless steel tubing with flanges screwed on and welded.

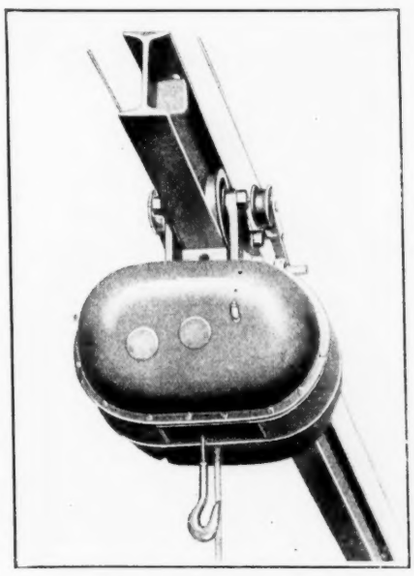
A new type of non-return stop check valve for working pressures up to 900 lb. and 750 deg. total temperature and designed for low pressure drop was exhibited by the Pittsburgh Valve Foundry & Construction Company. The valve is of cast-steel construction with either Monel or all alloy steel trim, and is fitted with a special type of handwheel and tightening screw for holding the disk tight against boiler test pressure.

The Consolidated Ashcroft Hancock Company, Inc., showed for the first time its line of forged steel valves in sizes from $\frac{3}{8}$- to 2-in. for pressure up to 450 lb. The valves are fitted with union bonnets and made in screwed and flange types. A new line of forged-steel valves for pressures above 500 lb., with offset body and pillar type yoke construction, were shown by the Edward Valve & Manufacturing Company.

A new pilot actuated back pressure valve designed for instantly relieving any pressure up to 100 lb., was included in the exhibit of the Atwood & Morrill Company. The valve has a single flat-seat poppet to which is rigidly connected a piston of larger area, which operates to open the valve and also hold it in the closed position. The operation of the valve is controlled by holding and relieving the pressure from the piston chamber by means of a pilot valve.

In addition to a cut-away model of its nozzle-type safety valve and a new-type locomotive pop safety valve, the Crosby Steam Gage & Valve Company featured a special reseating tool for reseating the Crosby high-pressure safety valve without removing the valve from the line.

A new device adaptable to a multiplicity of uses and known as "Hypressure Jenny" was included in

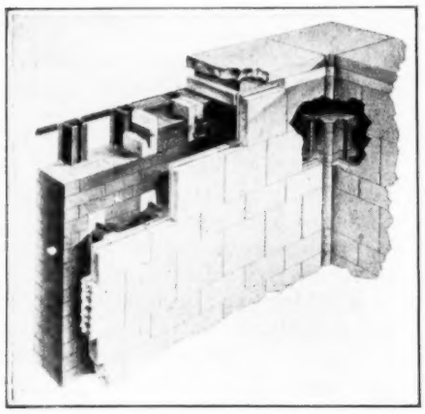


American Engineering Company's Lo-Hed electric hoist

the exhibit of the Homestead Valve & Manufacturing Company. The unit consists essentially of a small gasoline-fired tubular boiler for generating hot water and a motor pump for handling the water, solution, fuel feed, etc. The unit is especially adaptable to the cleaning of grease

and dirt from machines or buildings, thawing frozen equipment, sterilizing surfaces and container, etc. This company also showed its protected seat hydraulic operated valve of the remote control type. A feature of the Jenkins Brothers' exhibit was an oil drilling valve designed for 4,000 lb. pressure.

In addition to the various types of Yarway seatless blowoff valves the Yarnall Waring Company exhibited



Improved SX air-cooled furnace wall of the Drake Non-Clinkering Furnace Block Company

its new Yarway floatless Hi-lo alarm water column of forged steel equipped with Yarway "Sesure" inclined water gage. An operating model of a spray pond fitted with the type B spray nozzle, and a model of the automatic two-pressure valve control were also shown.

The Everlasting Valve Company showed for the first time its standard boiler blowoff valve with its improved disk spring, a conical spiral so wound that no coil touches any other coil even when complete compression takes place.

The Aero Fin Corporation, in addition to their standard low-pressure heating unit, showed a high-pressure element for operating at pressures up to 350 lb.

A new combination air washer and unit heater was displayed by the Carrier Engineering Company. In this unit air is drawn up through a water spray produced by nozzles at the end of rotating arms, through Aerofin heating elements, and discharged by a fan located on top of the unit.

A new gas-fired hot-air heating unit was also exhibited. In this unit a fan is provided for blowing, either outside or recirculated air over the metal plates in the heater unit and thence through pipes to parts of the building to be heated.

In addition to their standard unit heaters, the Modine Manufacturing Company showed a new utility heater of small capacity, consisting of a propeller type fan and fin heating unit.

The heating and ventilating unit of the Peerless Unit Ventilation Company has been improved and redesigned. The heater unit consists of two copper tubes surrounded by closely spaced fans, whereas the old types had 49 small tubes. A single-leaf damper has been provided, which takes the place of the interconnected fresh-air and recirculation dampers.

The Rome Brass Radiator Company showed a new electric-steam radiator. In the bottom of a radiator made up of welded brass sheet is installed an electric heating element. This element submerged in water produces steam that heats the rest of the radiator surface.

In addition to the new series of traps, described in *Power* Aug. 16 and Oct. 18, the Warren Webster & Company also exhibited a new dirt pocket, designed to replace the pockets usually made up of standard fittings.

At the booth of the Mechanical Manufacturing Company was shown a new fin-type heating element integrally cast of special aluminum alloy. The unit can be used for cooling as well as heating by circulating brine through it.

In the booth of the Clarage Fan Company was shown a new combination of unit heater and air conditioning equipment. Air drawn through a spray-type air washer, fin-type heating element, is discharged from a fan located on top of the unit.

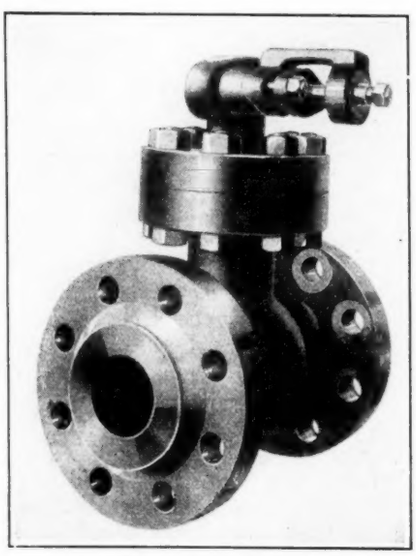
The Nash Engineering Company has made several changes in the design of their vacuum pump for use with systems having under 8,000 sq.ft. of radiation. The motor driving the pump is of the overhung type and is supported by castings fastened to the pump frame. The impeller has been changed to the closed type and a new air pump used that retains its water seal.

In addition to its standard unit heaters the L. J. Wing Manufacturing Company had at its booth a new electrically heated unit heater.

A somewhat elaborate exhibit was that of the Combustion Engineering Corporation. The entire back wall of the booth, which measured approximately 60 ft. long by 10 ft. high, was covered with a back-drop of black velour. In the center of this space two panels each were hung, on which were reproduced the tables which appeared in the 1927 Pulverized Fuel Report of the Prime Movers Committee of the N.E.L.A., showing all the power plants in the United States and Canada having boilers larger than 5,000 sq.ft., burning pulverized fuel with storage equipment. Check marks indicated the plant in which Lopulco equipment was used, the marks being illuminated from behind through transparent colored paper. Complete line of pulverized fuel equipment including the improved Couch burner and C. E. Air Heater were shown.

The Fuller Lehigh had an extensive array of photographs showing various types of installations already in operation and contracted for in addition to the latest type Bailey water wall.

A feature of the Bethlehem Steel Company exhibit that attracted a lot of interest consisted of models showing the various applications of the backlash eliminator and torque amplifier recently announced by this com-



Copes feed-water regulator valve with outboard ball bearing

pany and described in the Sept. 13 and 20 issues of *Power*. This company also showed a four-cylinder 120-hp. Diesel engine, an 8-ton per hour coal pulverizer and the Bethlehem-Weir feed pumps.

A new development in the field of lubricating apparatus was the pneumatic central lubricating system designed for feeding any number of bearings from one central point or station featured by the Keystone Lu-

bricating Company. The system consists essentially of a specially designed grease tank or container and a motor-driven air compressor with automatic control. From the tank one or more header lines are run with offsets or leads to the individual bearings, with a specially designed needle valve and telltale on each lead to control the feed of lubricant to each bearing. The units are made in two sizes with a lubricant capacity of 150 and 450 lb. and the pressure carried on the tank is 210 to 180 lb.

A new unit three-stage steam-jet air pump with inter- and after-condenser and isolating valves designed to produce a dead end vacuum of 29.9 referred to a 30-in. barometer, was shown by the Foster Wheeler Corporation. Also the new Foster air heater (Haber patents) and the latest type of Foster water wall in which metal block are welded to the back of the tubes to make a solid wall and increase the heat conduction to the tube.

A feature of the C. H. Wheeler Company's exhibit was the showing of sectional drawing of the Leach-Fracto condenser and heat exchanger which is now being built by this company. This condenser provides a means for close separation in the condenser of several distillate fractions allowing adjustments and control of one or more cooling mediums in the various vapor compartments. Two- and three-stage steam-jet air pumps with inter- and after-condensers were also shown.

The high-speed turbine-driven blower of recent design was exhibited by the Elliott Company. The blower is of the single-inlet overhung type with the impeller mounted directly on the end of the turbine shaft. The blower is being made in capacities from 1,000 to 32,000 cu.ft. per min. for pressures ranging from 0.75 to 3.5 lb. gage.

The Fisher Governor Company showed a new type sample head for obtaining a sample of oil passing through look boxes and giving a continuous reading of temperature and density. Also new turbulent, centrifugal and jet-type fluid mixers and a new type gas service control. A water and steam mixing unit for small uses was also shown by the Fulton Company.

An operating demonstration of the Garlock oil-return wall-plate metal packing was featured by the Garlock Packing Company. This packing was described in the June 28, 1927, issue. The cord plug for condenser cleaning recently brought out by this company was also shown.

A boiler return trap of 32,000 lb. per hour capacity of the latest improved type was included in the line of pumping and boiler-return trap equipment shown by the Bundy Steam Trap Company.

The Carborundum Company showed several new types of water-cooled and air-cooled walls using solid carborundum brick for the furnace lining.

At the booth of the Bernitz Furnace Appliance Company was shown for the first time the Thayer type water-cooled refractory wall. A complete description of this wall will be published in a later issue of *Power*.

The American Arch Company showed a section of unit supported wall in which some improvements have been made by replacing the vertical rods previously used for alignment of holding castings by special castings.

Several changes have been made in the design of the arch shown at the booth of the American Air-Cooled Block-Arch Combustion Company. The blocks used in the arch have been changed from 6 in. to 4 in. wide and the contour of the Venturi air space has been improved. The pipe section previously used for supporting the block has been replaced by a cast section which has simplified the wegdes used for holding the blocks.

The McLeod & Henry Company exhibited in addition to its standard "steel mixture," high-temperature cements and firebricks, a new carborundum-clay brick for services at temperatures of 4,000 degrees.

The Dampney Company of America exhibited its complete line of Apexior protective coatings for metal surfaces and the equipment for applying the coating. There was also displayed sections of boiler tubes that had been pickled for the removal of mill scale and later coated with Apexior. Samples showing the condition of the coating after various lengths of service under operating conditions were also available for inspection.

A section of the SX air-cooled wall for boiler furnaces, on which a number of improvements have recently been made, was exhibited by The Drake Non-Clinkering Furnace Block Company, Inc. In the construction of this wall, which is clearly shown in the illustration, the furnace side or renewable face of the wall is free to move both vertically and horizontally while being held in place by anchors embedded in the outer wall. Each narrow section of the wall is independent of the rest which facilitates the removal and replacement of blocks. The face blocks are of silicon-carbide.

A type of water-cooled furnace wall on which plastic refractory is used to form the wall at the back of the tube and also between the tubes was a feature of the Plibrico Jointless Firebrick Company's exhibit. This construction permits any tube spacing desired, to best meet the installation requirement of the water-cooled section.

A new type of soot cleaner valve operating head with totally inclosed gears was shown by the Vulcan Soot Cleaner Company and a new Model K-2 valve head in which separate chains are used for revolving the element and opening the valve was exhibited by the Bayer Company. A soot blower for plate-type air heater on which the nozzles are adjustable to permit correct setting for variations in the width of the heater sections was shown by the Prat-Daniel Corporation.

For controlling the differential pressure ahead of the feed-water regulating valve on high-pressure systems the Northern Equipment Company had a new combined regulator and governor, the governor being operated by a high-pressure sylphon bellows. This company also showed a multiple nozzle blow-down valve for pressures up to 1,500 lb.

In the new 4,500-lb. per hour superpower pulverized coal burner exhibited by the Furnace Engineering Company. A motor-driven fan is employed to give a more thorough mixing of the fuel and secondary air. The primary air and coal are admitted through the center of the burner, while the secondary air is admitted through ports in the front wall of the boiler and carried through a preheating chamber in the burner, finally passing through the outer section of the fan where it mixes with the primary air and coal. This company also showed a section of its water-cooled furnace wall in which the space between the tube is inclosed by blocks cast on the tube. The design makes the full area of the tube effective and reduces the insulation required on the outside.

EDITORIALS

F. R. LOW, *Editor*

Keeping Power Equipment Clean

ONE of the many problems in maintaining power-plant equipment is to keep it clean. After the plant is built and in operation, the prime requisite to good maintenance is cleanliness. One of the best indications of how a plant is being maintained is the degree of cleanliness that exists about the equipment and the operators in charge. Certain types of equipment, such as electrical, cannot be maintained in good condition unless kept clean.

To clean the dirt out of the windings and other parts of electrical equipment, compressed air has been used extensively. This method has the objection that it only moves the dirt from one place to another. In many cases a large part of it is blown into the atmosphere, only to settle back on the machine again or on some other machine, where it must be wiped off. The object should be to remove the dirt entirely, which can be done by a vacuum cleaner. Such equipment has been developed in both stationary and portable forms that will meet the requirements of almost any plant.

Piping installations and other equipment are frequently located in dark and inaccessible corners of the plant, where they are not wiped off every day and may collect considerable dust before they are cleaned. Even if they are wiped down, everything below them is subjected to a considerable quantity of falling dirt and dust. In such places a vacuum cleaner will not only make the job easier, but will do it without putting dirt on other equipment.

Where dirt is mixed with oil, such as on some parts of motors and generators, a vacuum cleaner may be unable to remove it. In such cases what can be removed with the vacuum cleaner should be taken off and then compressed air may be used to good advantage. The material that is now removed by compressed air is not the kind that will be carried in the atmosphere. There are certain mixtures of dirt and oil that cannot be removed by compressed air and must be scraped off or washed with a solvent.

Where the outside air is very dirty, it has been found advisable in some plants to use filters to remove the dirt from the air before it gets into the plant. This practice has many features in its favor. If the air contains carbon or other combustible dust, it creates a fire hazard when collected with oil in the windings of electrical machines. The dust is an electrical conductor and will have a tendency to cause short-circuits between uninsulated parts. It also has a tendency to work into cracks in insulation and cause breakdowns to ground.

A little dirt may appear to be inoffensive, but do not overlook the fact that it is at work all the time. Although there may be no way to evaluate exactly the damage done by dirt, it is known, other conditions being equal, that plants that are kept clean give the least trouble and have the best records for continuity of service.

Public Money for Losing Ventures

NOW and then somebody discovers a bit of a river and thinks it an excellent water-power site, spoiling for lack of development. Or, instead of a river, it may be any one of a number of other seemingly attractive projects. Mr. Somebody, being in a position to make his voice heard, forthwith launches a campaign for the appropriation of public funds for the development of his pet venture and for operation by the municipality or state for the benefit of the people.

One all-important question is too seldom raised at the outset of such enterprises. Why has this project not been developed by private capital? The reply is likely to fall into one of two classes—because of restrictive legislation or because it will not pay.

If ill-conceived legislation is retarding the proper development of business, the proper remedy is to modify the legislation.

If a proposed undertaking will not pay, why put public money into it?

The cost of furnishing an industrial service to the community, whether it be in tangible goods or in water or electricity supply, is the human effort put into it, initially to construct the necessary plant and structures, and currently to run the outfit. *All* the human effort. Cutting lumber for scaffolding and forms. Mining rock and making cement. Digging clay and making brick. Mining and smelting and refining iron. Rolling steel. Designing machinery. Pattern shop and foundry and machine shop skill and labor. Mining coal to melt and heat the metals used. Copper, rubber, cotton, brass, babbitt, porcelain, glass, mica, paint, varnish—what a host of things must be dug and worked and finally trans-

ported and put together before an engineering enterprise is ready to run! And every bit of this must be done by men working with hand and head.

And then the plant is started. Labor is needed for this too. Machines must be tended. Oil must be refined. Many supplies must be made and used. If it is a steam power plant, fuel must be mined and prepared and transported. And somebody has to do all that.

In considering a new proposal, a balance must be struck between doing or not doing the job. Will the result be worth the effort. And if two ways are suggested, which will yield the result with less effort?

It would be awkward to have to figure everything in terms of human effort. There is no scale of measurement. It cannot be measured in simple man-hours, for one man may produce community values a hundred times faster than another. The method of appraising values that has come to be used throughout civilized peoples is money. Instead of asking whether the end is worth the effort, we ask if the venture will pay. Instead of asking which of two methods demands less effort, we ask which is cheaper. Two ways of saying the same thing.

Fortunately, people with effort to exert, or with money to invest, are ever eager to undertake or underwrite ventures that promise an adequate return. In these days of organized industry they are not sitting idly waiting for such ventures to be brought to them, but they are actively scouting for new worlds to conquer. The chances are that Mr. Somebody's pet scheme for doing a big thing for his community has been examined by some of his fellow-citizens who are on the lookout for profitable enterprises. Why not let them do the job?

Generalization is dangerous in this, as in any other field of human activity. There are exceptions to the rule. There are public needs that must be met regardless of cost and profit. There are developments needed by the community that will ultimately prove profitable, though initially not so. Private capital cannot be expected always to be ready to pioneer for profits, however attractive, expected in the remote future.

Then, too, there are cases in which the community credit makes it possible for the government to borrow money cheaper than the individual or corporation, so that enterprises for which the cost of money is the predominant item can sometimes be handled most effectively by the government.

Again, private interests may have adopted obstructionist tactics to prevent the development by others of opportunities that they wish to reserve for their own future use. Perhaps they wish to stifle present competition. In the rare cases in which this dog-in-the-manger policy becomes evident, it may be necessary for the people, through their constituted authorities, to take a hand in the situation.

These are some of the obvious exceptions that demand special consideration and wise solution, but the general proposition still stands. If private capital and effort can be induced to do the work, why tie up the cumbrous and sometimes ineffectual machinery of public performance?

If uneconomic artificial restrictions of law or custom stand in the way, let them be swept away.

By all means, let private management be regulated fairly for the public weal, but let it not be unduly hampered in its willing desire to do the work of the world for fair wages.

If the project does not attract private enterprise because it will not pay, then it can hardly be made to pay if publicly constructed and operated. It is no better to invest public money than private in uneconomic developments.

The Value of Skill Is Increasing

SKILL is much more necessary in industry today than ever before. With the large output that prevails for each individual worker, just on a basis of his own labor the unskilled man can ruin vastly more material and waste far more time than he could in the past. And when we consider the modern tendency to organize so that one skilled man alone, assisted perhaps by a number of helpers, is responsible for a huge output, the necessity for that one man being as highly skilled as he can be is evident.

Along with this necessity for high skill has come a far greater reward for its exercise. The amount available for the remuneration of a skilled engineer in the Ford Motor Company is obviously greater than prevailed in a small wagon works in 1860. And the condition is the same if a modern power plant is compared with a plant of fifty years ago. The unit cost of the product, whether it be bathtubs or British thermal units, is constantly decreased, while the gross returns from the sale of the product increase. Industry may need relatively fewer skilled men, but it needs them more highly skilled and can afford to pay for that skill.

This situation is one that deserves the closest attention of the younger men in the power field. For success, they must be more skilled than ever their seniors in the profession needed to be. But if they are willing to make whatever sacrifices may be needed to acquire this superior equipment, they will find that their opportunities and rewards will exceed anything that their predecessors ever dreamed of.

The skill that the power plant engineer needs is more of the brain than of the hand. In the light of his knowledge of what happened yesterday, he must understand clearly what happens today, foresee intelligently and opportunely what is likely to happen to-morrow, and plan wisely to meet the expected situation.

IDEAS *from* PRACTICAL MEN

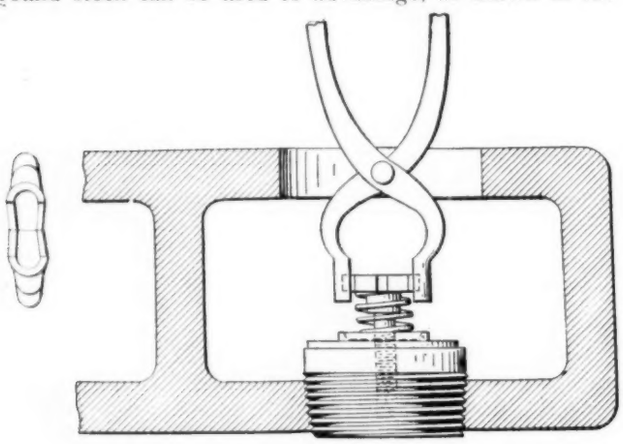
Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Handy Way to Remove Pump Valve Studs

THE valve studs in the lower deck of a duplex pump are generally hard to get at, but they have to be removed occasionally for facing or renewing the valves.

A special wrench for this purpose usually comes with the pump, but as it is used infrequently, it is often missing when needed.

In such a case a pair of blacksmith tongs for holding round stock can be used to advantage, as shown in the



Tongs used as valve stud wrench

illustration. An end view of the jaws of the tongs is shown at the left. P. EASTON.

Topeka, Kan.

The Plant Owner Is Not Always to Blame

THE plant owner has often been criticized for turning a deaf ear to requests for new equipment that is guaranteed to cut costs. Only recently, I heard from the lips of one of these owners a first-class argument in his defense. He had purchased, at the engineer's request, superheaters for two 78-in. return-tubular boilers. A third boiler, used only when one of the other two was shut down for cleaning or repairs, was not equipped with a superheater, because of its age.

The first year the equipment was given careful attention and 100 deg. superheat was secured, which improved the steam rate of the engine and speeded up a process that used high-pressure steam. Later on, the fuel bill increased by $200 a month and complaints began to come in from the mill that several traps were out of order. The engineer overhauled the traps and still the complaints came about reduced production. He advised larger traps and disclaimed all responsibility for increased fuel bills by showing his records, which proved that the evaporation of water per pound of coal was as good or better than formerly. An outside engineer was called in, and inside of 24 hours he made several discoveries that explained all the trouble.

First, he looked for a thermometer on the steam line to the engines and found one near the throttle of one engine. But it had been turned face to the wall, so reading was impossible. The engineer's explanation of this was that the fitting had leaked and a half turn with a wrench stopped it. A new thermometer was installed and showed about 30 deg. superheat, and he started to look for the cause. He found one of the superheater boilers out of service and the boiler without a superheater was on the line, which partly accounted for the drop in superheat. Investigation revealed that No. 1 boiler had been taken off the line for cleaning over two months before, but the cleaning was not even started.

On the night shift the steam thermometer showed no superheat whatever, and it was then that the greatest complaints came from the mill about faulty trap operation. The fireman was forcing the fire on No. 3 boiler with no superheater and had the hand damper closed on No. 2. His explanation was that No. 3 boiler was the nearest to the yard and coal wheeling to this boiler was much easier than to the other two, which were in the hottest part of the boiler room. Better ventilation, easier coal and ash handling caused No. 3 to be unduly forced, whereas it was meant only for a reserve unit.

The mill was getting wet steam instead of superheated steam, which naturally increased the amount of condensate going to the traps. While the traps could handle the normal quantity without difficulty, the additional water to be drained from the process was beyond their rated capacity. After the damper on No. 2 was opened wide and the fire became bright, the engineer noted a gradual increase in steam temperature and by carrying all the load possible on No. 2, the superheat ran up to 80 deg. The next day, cleaning was started on No. 1 and in two days it was back on the line.

The engineer was practicing false economy by operating No. 3 boiler for such a long period, but as his evaporation figure did not drop, he assumed the boiler to be as economical as the others. As it delivered wet steam instead of superheated, it really should have shown a higher evaporation.

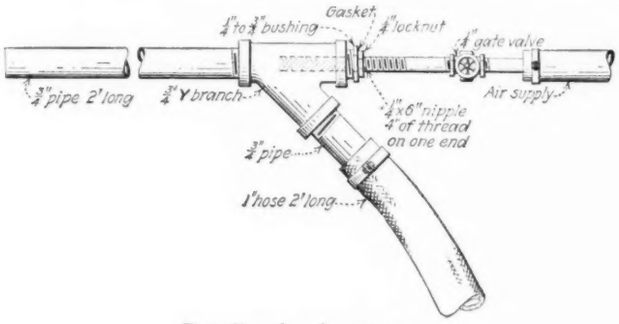
Naturally, after an owner has spent several thousand dollars for equipment for the purpose of reducing fuel costs, he has a right to expect that the power-plant crew will operate this equipment to give him the highest possible returns on his investment. A. F. SHEEHAN.

Springfield, Mass.

An Improvised Refractory Gun

THE illustration shows a refractory gun that can be made from parts found in almost any plant. A gun made of the parts indicated has been used in our plant with great success for patching leaky baffles and brickwork and any work where plastic material is used and cannot be applied with a trowel.

The parts needed are a $\frac{3}{4}$-in. Y-branch, a $\frac{1}{4}$x6-in. nipple, threaded for a length of about 4 in. on one end, a $\frac{1}{4}$ to $\frac{3}{4}$-in. bushing, a washer of some gasket material, a $\frac{1}{4}$-in.



Details of refractory gun

locknut, a $\frac{1}{4}$-in. gate valve, a $\frac{3}{4}$-in. pipe, about 2 ft. in length, a 1-in. hose of suitable length, and an air supply.

The parts are assembled as shown in the sketch, the long threaded end of the nipple being screwed into the bushing in the Y-branch, about as shown, the proper position being found by trial.

The refractory cement is mixed with water, the proper consistency being found by experiment, and is then drawn from a pail placed in some convenient position.

Duluth, Minn. L. M. LARSON.

Size and Layout of Exhaust Piping Important

IT IS a common thing to find steam mains, especially low-pressure and exhaust mains, so small that the desired capacity is obtained only by high velocity, which means large pressure drop. This is the principal reason so many objections are raised when the engineer tries to use exhaust steam in place of live steam in the interests of economy.

One plant where the engineer in charge tried it, refused to consider the use of exhaust for drying the product even though the temperature of the material being dried could not be raised beyond 212 deg. with any pressure of steam. With process temperatures below 212 the engineer considered it an ideal chance to use the exhaust of a small Corliss engine that was now going to the atmosphere. In refutation of his argument for economy, the manager said it had been tried and the loss in production due to stoppage offset the fuel gain.

But the engineer piped his exhaust line to the process with a shutoff valve, and on Saturday afternoon turned the exhaust into the process. The engine promptly slowed down and took steam full stroke. The process pressure was only 10 lb. and the engine was not overloaded, so he stayed the rest of the night trying to locate the trouble. The engine was about 150 ft. from the dryroom and the only low-pressure gage was in the dryroom.

The following day I went in at his request and looked the job over. I at once suggested that he put the gage nearer the engine so that he would know what the exhaust pressure was at the engine. I then asked to be shown the piping layout. The exhaust entered the heating system mains, and where the heating line entered the dryroom the connection for the drier was taken off. This roundabout path that the steam had to travel was the cause of the trouble. A 5-in. line direct to the drier was recommended, and it was finally installed.

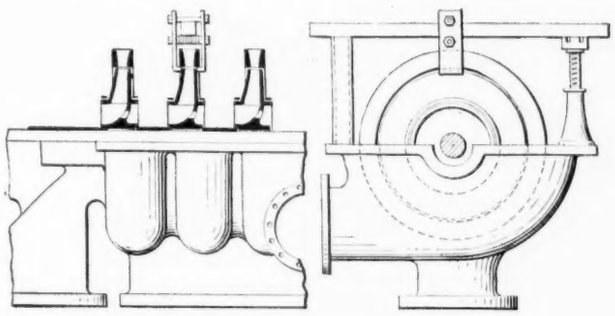
While doing the piping I turned the exhaust into the old line and found from indicator diagrams that the back pressure on the engine was 20 lb., the cause for this high pressure being the numerous elbows and valves between the engine and process. With the direct 5-in. connection all complaints ceased and a saving was effected.

From then on the engine ran smoothly and cutoff was not late enough to cause the governor to drop, and the speed was held constant. The former annoyance of slowing down and stopping created the prejudice against the use of exhaust steam, and I believe this is only one case out of many. G. H. HART.

Thompsonville, Conn.

Replacing Packing Sleeves on Multi-Stage Centrifugal Pump Shaft

SOME time ago we had to remove a runner shaft of a multi-stage centrifugal pump to put new bronze packing sleeves on the shaft. It was a Sunday job and we were anxious to get the work done as quickly as possible. We got the top half of the pump casing off, but could not move the runner seal rings, as they had been doped with white lead instead of graphite and oil when the pump was assembled previously. As we were



How seal rings were freed in pump casing

afraid of damaging the rings or bending the shaft by prying on it with a bar, we devised a means of loosening them without danger of damage to the pump.

We had a small screw jack on hand, and there were miscellaneous pieces of iron in the shop, so we made a clamp from two pieces of $\frac{3}{8}$x2-in. iron to hook under the sides of the ring, as shown in the illustration. We put a piece of $1\frac{1}{4}$-in. square iron bar through the clamp with one end resting on a short piece of pipe and the other on the jack. By screwing up slowly on the jack, the rings were raised separately and made free of the lower half of the pump casing. When the rings had all been loosened, the shaft and impeller assembly was removed without further difficulty. A. PULLEKINS.

Akron, Ohio.

COMMENTS *from* READERS

Causes of Dangerous Boiler Deterioration

IN THE article by C. E. Stromeyer on "Causes of Dangerous Boiler Deterioration" which appeared some months ago in *Power*, this statement is made: "Boiler sediment produced by compounds remains in the boilers, which is not the case where water softeners are used."

Having had experience in the use of both systems, I should be glad to know how Mr. Stromeyer reconciles such a statement with the deposits found in boilers using softened water and caused by the colloidal character of the deposits, due either to soda-lime or Zeolite softening, against which the filters of such systems are not 100 per cent effective. Such deposits lose their colloidal nature in the boiler and become crystalline and make scale.

Granted that it is considerably less than when no treatment at all is used, it impresses me as misleading to state deposits in boilers are "not the case" where water softeners are used.

The article in question also states: "No matter whether ordinary boiler compounds are used or water softeners, the soluble chemicals thus introduced remain in the boiler water and gradually increase its density until a point is reached when the salts separate out."

While agreeing with the writer on that statement, there is today a decided advantage in soluble salt content of a water. I refer to "conditioning" of boiler water instead of "softening" it, with respect to which I think many readers will be interested in the comparisons made in the following table.

	Raw Water	Lime-Soda Soft	Zeolite Soft	Colloidal Conditioned
Calcium carbonate	16.10	3.50	0.00	11.90
Calcium sulphate	7.30	0.00	0.00	4.20
Magnesium sulphate	6.42	0.00	0.00	5.00
Magnesium hydrate	0.00	0.60	0.00	0.00
Sodium carbonate	0.50	0.95	17.90	0.00
Sodium sulphate	7.10	28.24	28.24	11.04
Sodium chloride	1.10	1.10	1.10	0.60
Colloidal matter (organic)	0.00	0.00	0.00	4.12
Total solids	38.52	34.39	47.24	36.86

It will be noticed that the soluble salts (sodium) increase from 8.70 grains in the raw feed to 30.29 grains in the lime-soda softened water; from 8.70 grains to 47.24 grains in the Zeolite softened water; from 8.70 grains to 11.64 in the colloidal conditioned water.

Regarding the scale salts (first four mentioned in the table), while it will be seen that these are less in the Zeolite and lime-soda softened water, experience shows that under control of certain colloids these are enveloped as they become insoluble owing to the "protective colloids" carried by certain colloidal treatments that are in use today.

Further statement in the article reads: "Temporary hardness can be removed without introducing soluble salts, and barium salts have the advantage of removing both temporary and permanent hardness without adding soluble salts to the water and increasing the density."

All barium salts do not do this. For instance, "barium chloride" reacts with calcium sulphate (permanent hardness) to form barium sulphate (insoluble) and calcium chloride, which is very soluble. If barium chloride were used to treat temporary hardness such as calcium bicarbonate, the soluble salt (calcium chloride) would again be formed.

H. W. BANNISTER, Vice-President,
New York City. Feedwaters, Inc.

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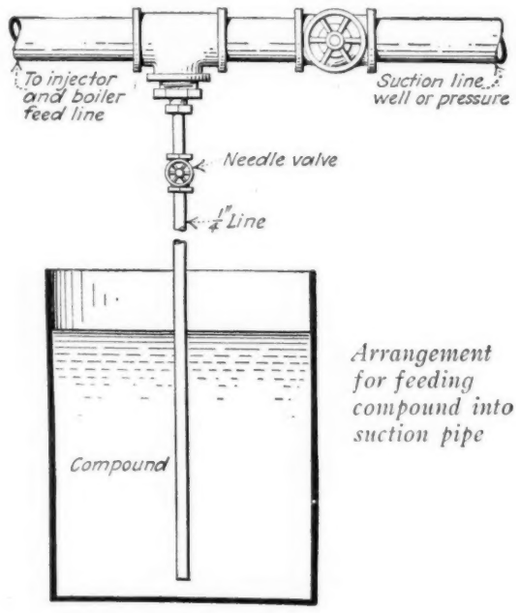
Methods of Feeding Boiler Compound

THE method of feeding boiler compound illustrated in Fig. 1, on page 409 of the Sept. 13 issue, will not work where the city pressure is higher than the boiler pressure with the water regulating valve placed as shown



Arrangement for feeding compound into suction pipe

in the illustration, as, obviously, when the valve *A* is opened, the pressure will force the compound out of the cup.

A less complicated method of accomplishing this result is illustrated herewith, which has additional advantages in that it requires no care after the compound is mixed, there is no lifting of the vessel containing the compound, and by adjusting the needle valve the compound can be fed into the boiler very slowly, one-half gallon per hour being quite practical.

An old 15-gal. oil drum with the top cut out and a little paint applied makes an ideal container. The ¼-in. line can be tapped directly into the suction line if desired, so

long as it is placed between the water regulating valve and the injector where city pressure is used; where a well or settling tank is used, any point in the suction line will suffice. H. McKENNA.

Seattle, Wash.

* * * *

More About Cutting Gage Glasses

A SIMPLE and reliable method of cutting gage glasses to any desired length consists in filing a notch, as G. C. W. Golem suggests in the Oct. 18 issue, then wrapping the tube with a strip of wet filter paper or paper towel on each side of the notch, leaving the space between the strips $\frac{1}{16}$ to $\frac{1}{8}$ in. wide. The strips of paper may be $\frac{1}{2}$ to $\frac{3}{4}$ in. wide and wrapped on about three layers deep. The fine flame of a blast burner is directed against the tube between the papers and at the notch for a second or two when the tube is slowly rotated in the flame. The tube should be turned rapidly enough to avoid burning the wet paper. At the completion of the revolution the tube will break off with a clean and even cut.

Short tubes for oil-sight feeds may be cut with ease by this method when it would be impossible to break them off from just a file notch. Bottles and large tubes are equally easy to cut.

In breaking a tube from a file notch, which is the universal method for small-diameter tube and rod, much depends on the nature of the file mark. Just as in cutting window glass, what you want is a cut and not a scratch, and in filing a notch completely around the tube, as advised in the answer to which Mr. Golem referred, even the inexperienced is likely to make a real cut at some point on the circumference, while in his hands the single file notch may not register the cut necessary for the clean break. RAYMOND L. DREW.

Arlington, N. J.

* * * *

The Unit Impact Pulverizer

THE editorial in the Sept. 13 issue on "The Unit Impact Pulverizer" is stimulating, and while the following may not be the answer asked for, I hope it will aid in bringing out the real status of impact pulverizer design.

As stated in the editorial, little change has been made in the general construction of these machines, and this statement holds true back to the time of the original Whelply patent granted in 1864. The essential impact principle of that machine is still the basis around which practically all machines of today are built, and improvements have been incorporated in the equipment now offered.

While some machines do incorporate so-called attrition elements, it is questionable whether these elements function as true attrition parts or whether, due to their speed, the real effect is not that of impact.

While the so-called attrition mills do permit rolling contact of the moving and stationary parts under light loads, these parts are usually separated by a film of material. The actual reduction of this material takes place, strictly speaking, by pressure due to the centrifugal effect of the revolving grinding elements, or in case this pressure is considered as being quickly applied the effect is actually more nearly that of impact.

In the case of ball mills it has been established that the efficiency of these machines is greatest when a true cascading of the balls takes place from near the top of the mill toward the bottom. This results in the greatest amount of impact of ball upon ball, ball upon material and material upon material.

On the basis of the foregoing, it seems reasonable to believe that the actual work done in practically all present-day pulverizers is done mainly by impact. This impact is developed by one of the following methods:

(1) Revolving swinging hammers; (2) Revolving rigid paddles or pins; (3) revolving rolls, balls or rings; (4) dropping or cascading balls; (5) dropping or cascading rods.

The question then resolves itself into a discussion as to the relative efficiency of each of these systems as incorporated in the respective machines of various designs. Manufacturers have investigated the operating principles of impact-type unit pulverizers, have made thorough studies of many factors entering into the operation and design of this type of machine, and while the results have not been published in the technical press, they have been applied to the product offered for sale. These improved designs have resulted in lowered maintenance, controlled pulverization, lowered power consumption, ease of operating control and smaller machines.

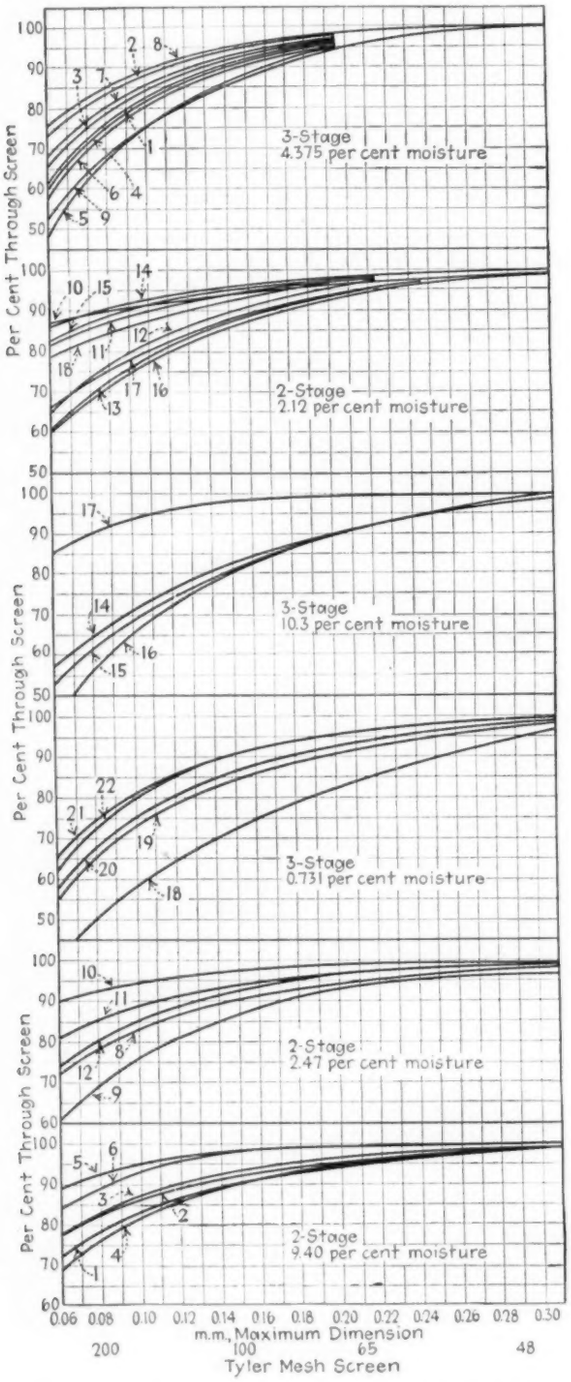
Such questions as most effective peripheral speeds, air velocities through the machine, division of work in various stages, reduction of no load power, paddle design, etc., have been thoroughly investigated. Some of these studies are quite valuable and have been made at no small expense. In view of the small patent protection obtainable on this type of equipment today, it has not been good policy for the manufacturer to broadcast the results of these investigations.

In the third paragraph of the editorial the statement is made that "Strangely enough, all these mills give substantially the same result, irrespective of the modus operandi, but furthermore, they all seem to encounter the same inherent difficulty—obtaining and maintaining satisfactory pulverization."

In this question of pulverization arises that one regarding the definition of the "fineness necessary for proper firing." A study of this over some 13 years has brought me to the conclusion that this pulverization should not be measured by reference to a 200-mesh screen. There is no definite relation between the percentage that goes through a 200-mesh screen and the percentage that remains upon, say, a 48,-50- or 60-mesh screen, yet it is this latter material that interferes with good combustion rather than the former. It is suggested that operators of coal pulverizing equipment give more consideration to screen analyses of the larger meshes, letting this be their guide rather than the 200-mesh material. It has been my experience that the percentage through a 48-mesh screen is of infinitely more value in deciding on the fineness suitable for good combustion than the percentage through 200-mesh. That this is true is exemplified to some extent by the accompanying curves from tests of an impact-type machine under various loads. The curves show a wide variation in the percentage of coal through 200-mesh, a smaller variation in that through 100-and a quite small variation in the percentage through a 48-mesh screen. With the 200-mesh coal varying from 50 to 90 per cent, the combustion

and furnace operation was not affected in the least, owing to the small percentage on the 48-mesh screen.

These curves also indicate that there is no advantage to be gained in too many stages so far as pulverization is concerned. Windage or eddy losses are increased with resultant higher no-load power.



CURVES FROM TESTS OF AN IMPACT TYPE MACHINE

Stage samples removed from pulverizers have given valuable information regarding the work performed in different stages at different peripheral speeds and air volumes. Investigation as to paddle shape has developed a paddle to give great radial impact rather than tangential impact on the circular liners. This results in more effective pulverization and lower maintenance, due to the more direct instead of glancing travel of the coal particle from paddle to liner. The proper design of the stationary liners, etc., within the mill has resulted in the better regulation of pulverization during the life of the mill.

The wide variation existing in the amount of active working surface within the various mills has undoubtedly resulted in the belief that the impact machine gives constantly and sometimes rapidly decreasing pulverization from beginning to end of the life of its wearing parts. In terms of square inches of paddle or hammer surface exposed for work, it is interesting to note that in the case of, say, a 5,000-lb. per hour machine the various machines range from a minimum of about 48 sq.in. to a maximum of about 1,860 in. per machine. Certainly 48 sq.in. will and is doing the work, but just as certainly a small amount of wear reduces rapidly the effectiveness of such a unit.

The method of capacity rating of unit pulverizers has to date been arbitrary, and in short it is largely dependent upon the size of motor applied to the unit with reasonable limits implied. I have seen machines rated at 1,000 lb. per hour deliver 3,000 lb. per hour with good pulverization. Naturally, the life of the machine at this latter capacity would be reduced in terms of operating hours.

Where the machine in new or renewed condition as to wearing parts is operated or rated nearly at its maximum as respects paddle or hammer area, air volume, peripheral speed, etc., then a gradual reduction in pulverization will be noticeable with its operation. Should the machine be more liberally designed and more conservatively rated, then it will be noted that the pulverization is maintained over a considerable period of time and then near the end of the life of the wearing parts a gradual decrease in pulverization may be noticed.

Rather than spend money for research on the problem of the amount of pulverization that can be done by impact and the amount necessary to do by "attrition," would it not be better to determine first the amount of pulverization that is required to give good combustion?

Among my early experiences with pulverized coal it was felt that, for the metallurgical work involved, 75 per cent of the coal must pass a 300-mesh screen. The screen was labeled "300-mesh" and the sample generally showed the desired percentage when shaken through this screen by hand. Today screen manufacturers will not, to my knowledge, supply a 300-mesh screen with guaranteed accuracy of openings, so we talk about the percentage through 200-mesh and the purchaser demands anything up to 95 per cent through 200-mesh. If we persist in adhering to the 200-mesh screen, when will we settle on a standard screen or speak in terms of a standard screen opening? The 200-mesh screens, as offered for sale today, may vary as much as 52 per cent in the area of the opening, dependent upon the series of standards used, such as Tyler and U. S. Bureau of Mines, or Hoover, Rittinger, and Mining and Metallurgy.

The unit impact pulverizer is fully capable of giving the necessary pulverization required for combustion without the aid of any "attrition" assistance.

The reduction in plant investment with the unit machine, reduction of labor and operating hazards, greater reliability, lower maintenance and simplicity of installation and operation, are the factors that are giving the unit pulverizer the foothold in the larger central stations.

Birmingham, Ala. W. W. PETTIBONE.

Advantages of Firing Light and Often Demonstrated by Using Thermometer in Uptake

WISHING to impress upon the mind of my fireman the effects of a heavy covering of the fire and also keeping the firedoors open too long, a simple experiment was used that may be of interest to readers of *Power*.

A portable thermometer registering up to 950 deg. F. was placed in the uptake of the boiler, directly below the damper. The exit gases average 535 deg., and the draft carried was around 0.35 in. The fireman by this time was showing decided interest. Telling him to cover the fire and with watch in hand, I watched him. He threw fourteen scoops of coal on the fire, each weighing about 15 lb., making approximately 210 lb. of coal. The time taken to cover the fire was 70 seconds, that is, from the time the firebox doors were first opened until they were again closed. The portable thermometer told the story and the fireman was much impressed—more so than by any lecture of mine. The temperature of the exit gases dropped to 420 degrees.

When the door was closed, the temperature remained there for a while, dropped somewhat lower and then began to rise slowly until it was again 535 deg. The fireman viewed this in surprise. The whole operation took about two and a half minutes. The fireman, being somewhat above the average, realized that this method of firing was wrong and decided to profit by what he had seen. The next time he covered fire he put in 6 scoops of coal each weighing about 15 lb., making about 90 lb. in all. The time element between the opening and the closing of the firedoors was about thirty seconds. The improvement was immediately noticeable. The temperture dropped from 535 to 485 deg., hung there momentarily, and slowly began to rise to the usual point. The whole operation took hardly more than a minute and a half.

A good lesson was taught with a minimum of effort, the fireman was not antagonized, and the economy of the plant was increased.

G. T. MICHAELS.

New York City.

* * * *

The Engineer in Civil Life

THE editorial in the Oct. 18 issue entitled, "The Engineer in Civil Life," discusses a matter that should be of interest, not only to engineers, but to the members of many other professions.

If we are to find a remedy, it will be well to inquire into the history of the disease and attempt to discover why the acceptance of free service by perfectly solvent communities which is an act of pauperism, should in most cases be looked upon as a virtue rather than a vice.

If we look into the early history of European civilization, from which our own has sprung, we find that as a matter of economic and military necessity the ownership of property was centered in the hands of the few, who for their own protection, if for no better reason, were compelled to administer their wealth for the support of the many.

This created a relationship of overload and dependent, and down through the centuries until recent times it has been the prerogative of the ruling classes to give, and the ingrained habit and often the necessity of the more dependent classes to receive.

It is no use denying that this created a situation that was extremely flattering to the self-esteem of the more fortunate members of the community. To be "Lord of the Manor" in this world and feel that there is at least a sporting chance that your generosity will secure you preferential consideration in the next, is the kind of thing which, in some form or other, few of us mere humans can resist.

Those who, like myself, were born on "the other side," in not too recent years, will no doubt remember ludicrous instances not untinged with tragedy, of attempts to live up to the obsolete rule that a "gentleman" must not work for pay.

Now racial customs die hard, and although we pride ourselves in this country that we have risen superior to such absurdities, it is still true that there are too many people who feel that it is a mark of superiority to give under circumstances which, from a sound economic point of view, do not justify such action, and who fail to recognize the fact that acceptance of such gifts makes them responsible for the pauperization of the recipient.

I think that we shall all agree that one of our great American ideals is the achievement of economic independence for every member of the community, and although we have some distance to go, never in the history of the world has such progress been made in this direction.

The poor we still have with us and perhaps always shall, but more and more we are coming to realize that the relief of unavoidable distress is a public duty rather than a matter for private charity, but the principle of economic independence cannot be properly established until it can be applied both to the individual and to public bodies. To demand economic independence for ourselves and then encourage our representatives to violate this principle in the conduct of our corporate affairs cannot fail to be self-destructive.

We should be careful to make distinction between different classes of public service that have developed under our present economic system.

On the one hand we have a number of men whom our highly productive industrial system has enabled to accumulate wealth far in excess of their personal needs, and it is quite reasonable that they should recognize the fact that their right to such wealth can be morally justified only on the ground that they hold it as a public trust, and on the other hand we have a certain number of professional men who, owing to the opportunities afforded by the great business structure which has been erected by others, are enabled to obtain rates of remuneration that might appear excessive when applied to public work, and it would be quite reasonable for them to offer their services at rates more in accordance with the average standard, but this is quite a different matter from offering their services free.

I am of the opinion that both the responsibility and the remedy for the present unsatisfactory situation lie to a great extent in our own hands. When we get up enough courage to refuse unjustifiable demands and when we cease to pander to our own self-esteem by bidding for public applause, the thing will stop, and until we do, it will not.

J. O. G. GIBBONS.

Newark, N. J.

Practical Refrigerating Engineers Hold Convention at San Francisco

THE Eighteenth Annual Convention of the National Association of Practical Refrigerating Engineers was opened by President B. S. T. Dobree, at the Municipal Auditorium, San Francisco, Calif., on the morning of November 29.

After listening to an address of welcome, which, in the absence of Mayor James Rolph, was delivered by his secretary, and a response by Fred I. McCandlish, the convention gave its attention to the reports of the several standing committees. It was reported that while 547 new members had been added during the year, 399 had been dropped for various reasons, and five new chapters had been organized. The general expression was that the difficulty in holding members was traceable to the deficiencies in the educational program. More complete and practical lecturers were needed.

Tuesday Afternoon Session

In the afternoon a series of questions were propounded by John A. Hawkins, and answers were received from the attending engineers, and the variety of solutions offered gave some indication of the haze that surrounds many of the physical laws.

In a paper entitled "Selection, Installation and Operation of Ammonia Compressors," W. D. Whaley discussed more especially the overhauling of compressors. He pointed out that during the months when the plant was busiest, the defects in the machinery were most obvious, and recommended that a log or record be kept of the various adjustments needed, so that when the plant was shut down in winter, all parts would receive attention.

He said that most of the repair work should be performed by the operating force, but even where such jobs as cylinder reboring was turned over to an outside shop, the engineer should see that the boring bar was properly aligned and of a capacity suitable for the work to be done. After a cylinder had been rebored, the surface should be scraped lightly to remove the fine metallic chips. The speaker was not in favor of smooth finishing piston rings, as he felt that a rough cut gave a better surface to be worn into a fit with the cylinder bore. As for shaft bearings he was opposed to brass-boxes and felt that babbitt made a superior surface. In case of crankpin bearings, however, the babbitt should be of high grade, as cheap antifriction metal would not stand up under the load.

The habit of engineers of permitting compressors to shift on the foundations was deplored. When this exists, new grouting should be run in and the bolts tightened.

Corrosion in Ice Plants

In his paper, "Corrosion in Ice Plants," H. L. Lincoln gave a résumé of the several causes of ice-can corrosion and the remedies that had been suggested. He said that it had been established that in the case of sodium chloride brine the corrosion varied inversely with the density. The author believed that this explained the present-day rapidity of corrosion compared to the slow wasting away of the past, inasmuch as low-density brine was in general use. He recommended plenty of salt in the brine.

Tests, so he said, proved that the brine should be kept neutral or at best but slightly alkaline or acidulous. The engineer could test for ammonia leaks into the brine by using Nessler's solution, but as this did not reveal the degree of alkalinity, a more exact method was desirable. Such a method consisted of finding the relative hydrogen ion concentration. He demonstrated this method, using phenolphthalein as the reagent. If the concentration was positive, the phenolphthalein ranging from 8 to 9.5, the brine would turn pink, the tint deepening as the phenolphthalein increased. If the brine was slightly alkaline, the phenolphthalein would average 8.3. He said this was the best operating value as long as the galvanizing was intact, but for bare iron cans the value could be raised to 9. When the alkalinity became high, the author stated he had placed a charge of sulphuric acid in the brine tank. Research had revealed that corrosion could be prevented through the addition of sodium dichromate or sodium diphosphate in sodium brine. Many compounds were offered for sale, most of which contained sodium silicate.

In the discussion it was brought out that zinc dust added to the brine delayed can corrosion. It was also stated that the phenolphthalein test would not

Delegates and Their Guests at the Practical

apply to calcium chloride, but a suitable test had recently been developed in England. A delegate stated that to clear brine he had used a so-called rusticide with entire satisfaction.

The educational feature of the organization was discussed at a dinner on Tuesday evening. A number of the members indicated that a series of lectures on elementary physics was needed. It had been found that the present set of lectures failed to deal with basic principles. The problem of holding the interest of older members while providing educational matter suitable for the less-experienced men, was a difficult problem, and this was left to the directors for solution.

Wednesday and Thursday Morning Sessions

The Wednesday morning session was enlivened by a demonstration by S. C. Dickinson, of the prone method of resuscitation. The speaker explained that the cessation of breathing experienced by a man through an electric shock and through inhaling ammonia fumes were identical, being a shock to the nervous and muscular systems. He demonstrated how to place the injured party and how to set up artificial breathing. That efforts should not cease until rigor mortis set in was emphasized, and he was strong in his insistence that a doctor's verdict of death should be disregarded until the patient became cold. A pulmotor should never be used, for the vacuum induced was too great for the delicate lung tissues.

This talk was followed by a paper on "Efficient Operating Organizations," by George A. Pardee, who discussed the best method of creating and maintaining an efficient force. Subordinates should be encouraged to become better engineers even though this might mean seeing them go elsewhere to fill better positions. The gist of the paper was that the chief engineer should play fair with those under him.

A number of questions handed in by members were presented by H. G. Venerman at the opening of the Thursday morning session. One arousing much discussion was: "What is the advantage of keeping brine clean?" While various answers were given, the consensus of opinion was that the dirt would form a coating on the ice cans and interfere with the heat transfer. The old problem of the relative melting rates of storage ice and new ice found many solutions. That old ice melts faster was claimed by some, and an equal number of the engineers denied the statement.

This discussion was followed by an illuminating talk by John M. Dodds on "Elementary Conception of Synchronous Motors." The speaker developed the electrical action by analogy with a crank-and-rod mechanism.

Cooling Towers and Ponds in the South

The paper, "Cooling Towers and Ponds in the South," by Walter Moses, dealt with the cooling-water temperatures obtainable with towers and spray ponds in New Orleans. The speaker stated that while chimney and forced-draft types of cooling towers were in use, the atmospheric type was preferred for refrigerating plants, for the reason that the chimney design entailed a high stack and did not give efficient results. The forced-draft tower failed to give as low a temperature as five degrees above the wet-bulb without excessive fan power.

It was strongly recommended that the louvers be made of cypress or cedar and that they be securely anchored to prevent vibration. The roof, if the tower or spray pond is on the roof, should be covered with a high-grade five-ply "Barrett specification" coat. Towers at least 30 ft. high were advisable, and the rectangular form was preferred to the square, with the long side at right angles to the prevailing winds. Such towers had been erected in New Orleans where the failure of wells formerly used, forced the construction of cooling apparatus. Head pressures of 190 lb. had been carried, even though the wet-bulb temperature went up to 80 deg. F.

J. R. Bernd held the attention of the convention by the ideas he advanced in his paper on "A Modern Freezing Tank." He expressed his disapproval of the conventional ten-pipe evaporating coil and claimed that cracked ice was due to the difference in the top and bottom tank temperatures. This difference resulted in the ice cake having a higher temperature at its top, and when placed in the thawing tank it cracked at the plane of temperature demarkation.

To prevent this the coil should be short and the gas permitted to reach the suction line without spilling over any liquid. He showed the design of the coils in the Fulton Ice Company's plant and claimed that the precooling coil in the accumulator enabled the ice tank to produce 16 per cent more ice. In the tank five pipes were connected in multiple with a liquid header and these five pipes were provided with return lines above the set, leading to the short suction manifold. The manifolds in turn were connected to the suction header. The advantage claimed was that the shorter gas path reduced the pressure drop to less than one pound.

Thursday Afternoon Session

At the Thursday afternoon session H. G. Venerman presented a paper on "Automatic Control Valves." Most of the valves installed in small refrigerating plants to give automatic control, he said, depend either on variations in the evaporating-coil liquid level or upon a change in the coil pressure. The result is that these valves would not control all conditions. It is quite possible for a float control valve to reduce the liquid flow at a time when the storage room needs the maximum amount of heat removing medium. Likewise, the pressure-controlled valve cannot regulate the room temperature.

These objections prompted the design of a temperature-controlled valve to

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regulate the liquid flow to the coils. The apparatus, he said, consisted of a small evaporator or heater surrounding a section of the suction line. This heater was connected above the diaphragm of the expansion valve, and the connecting pipe was partly filled with liquid ammonia. The suction gas heats the ammonia vapor in the heater element and the resulting pressure acted on the diaphragm. If liquid was pulled over into the suction line, the gas in the element was chilled and the resulting decrease in pressure on the diaphragm caused the expansion valve to close partly or totally. A low liquid level in the coils resulted in the suction gas increasing in superheat and the warming of the ammonia vapor in the element caused the cock to open wider.

In the discussion several pointed out that it was impossible to control several storage rooms with a single control valve and insisted that each room would require a separate control valve; with the design under discussion this seemed impossible to arrange since the heating elements would be on the common suction line. Others were emphatically of the opinion that several rooms could be hooked up with the coils in series, so that one control valve could handle all the rooms.

Charles W. Chapman then showed a number of slides of the storage room arrangement of the Detroit Refrigerating Company.

Friday Morning Session

At the Friday morning session a paper on "Humidity Control," by Charles A. Moore, was read. In this paper recommendations were made that all storage rooms be properly ventilated. All perishable goods absorbed oxygen and gave off carbon dioxide, and if new air was not introduced the room would hold a large percentage of carbon dioxide. As this gas has an affinity for moisture, the air would show a decrease in humidity and the goods would begin to lose some of their moisture content. On the other hand, if the humidity became too high, moisture would deposit on the goods.

Other papers presented at this meeting were "Ozone in the Cold Storage Plant," by F. E. Hartman; "Insulating Materials," by J. C. Peebles, and "Synthetic Ammonia," by H. A. Sommers.

Friday Afternoon Session

At the Friday afternoon session committee reports were received and officers for the ensuing year were elected. The new officers are: President, Fred I. McCandlish, Texarkana, Ark.; first vice-president, F. B. Fulmer, Oakland, Calif.; second vice-president, George A. Pardee, Louisville, Ky.; secretary, Edward H. Fox, Chicago, Ill.; treasurer, G. H. Chamberlain, St. Louis, Mo.; sergeant-at-arms, Ed. Tibbetts, Pittsburgh, Pa.

By unanimous vote of the delegates, Louisville, Ky., was designated as the convention city for 1928.

Owing to the great distance to San Francisco, the majority of the Chapters of the East and Mid-West were scantily represented. The closeness in time of the New York Power Show served to limit the number of exhibitors. In spite of these factors the convention was a success. A number of the papers were distinctly of a high caliber, and these will be published in later issues of *Power*. The San Francisco chapter is to be congratulated on the entertainment features provided. The visiting ladies were busy every day sight seeing in the city and adjacent country with its many attractions.

A.I.S.E.E. Discuss Grounding Electrical Equipment

GROUNDING for safety was the subject discussed at the Association of Iron and Steel Electrical Engineers, Philadelphia Section meeting, held in Reading, Pa., Saturday evening, Dec. 3. The discussion was opened by W. M. Runyon, who presented a paper in which modern methods of grounding electric circuits and equipment were outlined. Mr. Runyon differentiated between a grounded circuit or device and grounding for safety. A grounded circuit may be connected to earth or it may not. For example, a point in a motor winding may be in contact with the core and the winding is said to be grounded, even when the motor frame is insulated from the earth. A circuit may have a ground return, in which case the earth connection is intended to carry the current of one side of the circuit.

Safety grounds on circuits and equipment are always earthed and are not intended to carry current except in emergency, such as when the winding insulation of motors break down or when conductors come in contact with conduit on other objects. In such cases the flow of current to earth opens the protective device and removes the defective equipment from service. The purpose of safety grounding is to eliminate fire hazards and the danger of shocks to those working around electric devices and circuits.

A polarized system of wiring was described in which a white wire was used for the ground wire. This wire is not fused and is tied in with all conduit and the frames of all devices on the system and to a common ground, preferably a water main. In lamp sockets the white or grounded wire is connected to the threaded part of the socket and the opposite side of the circuit to the center contact. This places the ungrounded side of the circuit in a position to give the least danger from grounding to the outer shell of the socket. Mr. Runyon said that 250,000 installations of polarized wiring had been made and the cost of making these installations compared favorably with other types of wiring.

The low-voltage shock hazard was pronounced to be on the increase owing to the increased use of electricity. This increase in use of electricity had a tendency to breed contempt for the danger, on account of people's familiarity with this class of apparatus. These hazards are of two classes: one where a high-voltage circuit comes in contact with a low-voltage circuit and the other from the low-voltage, of which, under favorable circumstances 110 volts is fatal. Safety grounding under most conditions can eliminate these hazards. Portable devices, however, offer the most serious problem. It is proposed that all extension wiring to portable devices carry a third wire for grounding the frame of the equipment. In Canada and in some states such wiring is mandatory.

Where artificial grounds are used, it was recommended that lightning arresters be connected to a separate grounding system from the transformers and other equipment. Where pipes are used, these should be spaced about 10 ft. apart. These pipes should be tied together by cables, to which all ground connections are made.

In the discussion the necessity of periodically checking up on ground connections was emphasized to insure that a good ground existed when it was needed. A system that was supposed to be protected with safety grounds, but had been neglected and the ground connections become ineffective, was considered a greater hazard than when no grounds were used.

The grounding of portable equipment was the subject of considerable discussion. It was pointed out that many serious accidents had occurred on such equipment. In one case three men were killed and a fourth seriously injured by coming into contact with a portable conveyor to which its motor power circuit had become grounded. Although the conveyor was in contact with the earth, the resistance of the bearing of the transport wheels was sufficient to insulate practically the conveyor from the earth.

Opinion was expressed that, although it was desirable to make electric circuits safe, the tendency toward simplifying wiring should not be overlooked. If the cost of wiring is made too high, there will be a tendency to use makeshifts that will lead to dangerous conditions. The desirable thing, if it can be done with safety, is to decrease the complications of wiring rather than add to them, as the present systems add an undue burden to the industry.

NEWS *of the* FIELD

Plans for Third Midwest Power Conference Draw Program of Wide Interest

Power Development in Relation to Flood Control, Irrigation, and National Defense—Economies of Super-Power Systems to Be Discussed

THE keynote of the third Midwest Power Conference which will be held in Chicago, Feb. 14-17 inclusive, has been expressed by the statement of purpose: "To cover the broader, national and regional and economic phases of the power situation, and to present broader problems in such a way as to appeal more directly to the operating and technical interests."

Conformable to this general purpose the Conference will consist of a series of sessions each of which is to be devoted to the presentation of papers and discussions covering specific problems of widespread interest and importance, such as the relation of power development to flood control and other river problems; relation of power development to national defense, the social aspects of power development, and the economics of super-power systems.

Some Papers Slated

The details of the program in so far as they relate to the first subject are of timely interest. A paper is proposed on "The General Flood Control Problem on the Mississippi System"; another on "Problems of Storage for Flood Control and for Power Development"; one on the "Irrigation and Power Development Problems on the Colorado River"; and a fourth covering "Navigation and Power Development on the St. Lawrence River."

In view of the National significance of the Mississippi Flood situation, the Boulder Dam development on the Colorado River, and the improvement of the St. Lawrence River for both navigation and water power purposes, these papers, delivered by national authorities, should merit considerable attention.

These and other papers of general interest are to be supplemented by some of a more technical nature, details of which are not as yet available.

Backed by Societies

The Midwest Power Conference is sponsored and endorsed by the American Institution of Electrical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, American Institution of Mining and Metallurgical Engineers, National Electric Light Association, Western Society of Engineers, National Safety Council, American Society of Heating and Ventilating Engineers, and the American Society of Refrigerating Engineers.

The meetings are to be held at the Hotel Stevens, and are to be open to all interested, regardless of membership in the sponsor societies.

Central Maine Power Builds Another Plant

Active work has begun on another power development on the Lewiston side of the Androscoggin River by the Central Maine Power Company, directly across from its Deer Rips plant, which will generate 5,500 hp. The new plant will use the Deer Rips dam by utilizing water now going to waste when the new Gulf Island development, a mile above, is running at full capacity. When the new plant is completed, it will make the third within a distance of one mile on this river, from which a total of more than 40,000 hp. will be generated.

The new station will consist of a single generating unit, operated by remote control from the station across the river.

It is expected, considering present favorable indications of progress already made, that this development will be completed in the Spring.

Petroleum Institute Studies Conservation Plan

The board of directors of the American Petroleum Institute, meeting in Chicago, Dec. 7, discussed the problem of gas conservation to insure more thorough recovery of oil from sands. The Marland report advocating advanced steps to enforce the use of back gas pressures faced a minority report from Henry McGraw, vice-president of of Gypsy Oil Company, a subsidiary of the Gulf Company. The McGraw report developed strong support from Standard of Indiana and other companies, it is said, and the directors will resume deliberations on a gas conservation policy, when national officers are elected. Amos L. Beaty, chairman of the board of the Texas Company, is considered a likely choice of the institute for president.

The attention given by the oil industry to the problem of conservation in a year when overproduction has forced prices down and demoralized large sections of the oil business is testimony to the industry's capacity to take long views. How to sell oil, or how to get the money to store the excess oil available, is the immediate problem facing the companies.

Harry L. Doherty wired a telegram willing to work with the industry toward conservation.

Stockham Company Announces Changes in Personnel

Coincident with the announcement of the Stockham Pipe and Fittings Company, Birmingham, Ala., of the addition of Electric Steel Flanged Fittings and Flanges to the company's line of cast-iron and malleable fittings, certain changes in the executive personnel of the organization, have been made known.

Owing to the resignation of George B. Baldwin, vice-president in charge of sales, Douglass W. Stockham, secretary, has been advanced to that position. Mr. Baldwin has been with the company for many years, and now he resigns to engage in business in Chicago. He has organized George B. Baldwin & Company, and will engage in the general plumbing and heating supply jobbing business in Chicago.

Twenty-fifth Anniversary

Roy L. Stewart, Pacific Coast representative for the last five years, has been transferred to the general offices at Birmingham, and will be manager of sales. Harry N. Hall, of Philadelphia, has been appointed advertising and sales promotion manager. Germer Petesch, formerly manager of the Boston warehouse has been transferred to the Chicago warehouse, which he will manage. H. G. Farnum has been promoted to manager of the Boston warehouse.

Irving Lyon, steel sales engineer, manager of the Crandall Packing Company, Birmingham, for a number of years, has been appointed manager of the steel sales promotion department of the Stockham company. Mr. Lyon will be in the office in Birmingham.

The Stockham Pipe & Fittings Company has just celebrated its 25th anniversary.

Heating and Ventilating Men Plan Annual Meeting

Members and guests of the American Society of Heating and Ventilating Engineers will gather at the Hotel Pennsylvania in New York City for the Society's 34th annual meeting, Jan. 23 to 26.

The members of the New York Chapter, hosts at the meeting, have planned an extensive program. Special arrangements have been made with the Hotel Pennsylvania to care for all members arriving at the hotel Jan. 23. Registrations will be under the management of W. H. Driscoll. Those planning to attend can make reservations through R. Donnelly, chairman of the hotel committee, 29 West 39th St., New York City. Technical features will begin at 1:30 Monday afternoon, when President F. Paul Anderson will open the meeting. Technical papers will follow the report of the tellers on the election of officers.

One session this year is to be devoted to a discussion of factory heating and ventilation, a new departure. Another session is to take up the various codes now pending before the Society, including those on heating and ventilating garages rating low pressure boilers, testing building insulation and air cleaning devices.

The committee on research will tell of the progress of this work. It is also planned to hear from the committee appointed at the White Sulphur Springs meeting whose duty was to recommend a procedure in the co-ordination of existing facilities and data from all research laboratory investigations, and to study the use of central agency to make these data available to those who are interested or who contemplate further research in the heating and ventilating fields. Several nationally known speakers will talk at this session.

Entertainment will include a tea dance Monday afternoon, the past presidents' dinner on Monday evening, a theatre party for the ladies on Wednesday afternoon, and the banquet and dance, which will be held on Tuesday evening. One of the featured speakers will be A. O. Stanley, former United States Senator from Kentucky and formerly Governor of Kentucky.

Timothy Healy Honored at Testimonial Dinner

A testimonial banquet in honor of Timothy Healy was tendered by his friends and associates at the Hotel Commodore, New York City, Dec. 7.

About 500 persons, including groups of engineers, industrialists and labor leaders were in attendance. Those who expressed their appreciation of the work the guest of honor had done for the amelioration of the condition of the firemen in industrial and marine service were James J. Davis, Secretary of Labor; Bird S. Coler, Commissioner of Welfare of the City of New York; William F. Yates, president of the Marine Engineers Beneficial Association; Frank McKenna, John P. Burke, John P. Noonan and Commander John H. Banard.

Mr. Healy in a very happy talk told of his many years of association in the labor movement, the early struggles and vicissitudes of the firemen's organization of which he was international president until his recent retirement.

William J. Brennan made an excellent toastmaster, introducing the various speakers in a pleasing manner. John Sullivan served as chairman on the committee of arrangements.

Kansas Farmers Pay Visit to General Electric Plant

A party of Kansas farmers spent Dec. 2 in Schenectady, N. Y., visiting the plant of the General Electric Company. The visit was part of a two-week tour of the east sponsored by Senator Arthur Capper of Kansas. The party left Topeka, Kan., Nov. 27, and the trip was concluded Dec. 10.

A desire to investigate the possibilities of rural electrification at first hand was one of the main reasons for the investigation of the General Electric plant. A dinner in their honor was given by that company in the evening.

Sees Newton's Work of Lasting Value

SIR ISAAC NEWTON'S work, considered in its entirety as a basis for present and future scientific and engineering progress, was the subject of a two-day meeting of leaders in the fields of chemistry, physics and applied science commemorating the 200th anniversary of the English philosopher's death, held at the American Museum of Natural History, New York City, Nov. 25 and 26.

The sessions were arranged under the auspices of the History of Science Society in collaboration with the American Astronomical Society, American Mathematical Society, American Physical Society and the Mathematical Association of America.

That Newton's philosophy of gravitation will remain as a basis for the study of future scientists despite the discrepancies which the Einstein theory of relativity may show in it, was held by Prof. G. D. Birkhoff, of Harvard, "because the English scientist's laws were simpler.

"Newton's theories were on space, time and gravitation," said Doctor Birkhoff. "They still hold good and are still taught in the schools."

Uniform Coining System

Dr. Michael I. Pupin, of Columbia University, referred to Newton's science of dynamics as his greatest achievement, and the "crowning event of the two centuries of scientific inquiry which preceded him."

He emphasized that the discovery of America was the final experiment in proving that the earth was a terrestrial globe, that Columbus encouraged Copernicus, Galileo and other scientists preceding Newton, who succeeded where others had failed because he recognized that mass was the most important element which determined motion. This, he said, encouraged the electromagnetic experiments of James Clerk Maxwell, the Scottish physicist, and that Newton and Maxwell "blazed the path to the high level of knowledge from which we are today making a new survey of the universe, inspiring the belief that soon a new dynamic science will be born."

Other speakers Nov. 25 were Dr. David Eugene Smith, of Columbia, who spoke on Newton's life and work; Dr. D. C. Miller, of the Case School of Applied Science, on "Newton and Optics"; Dr. W. W. Campbell of the University of California, on "Newton's Influence on the Development of Astrophysics," which he said was still the basis of astronomy; Dr. Paul R. Heyl, of the United States Bureau of Standards, on "Newton as an Experimenter," and Dr. E. W. Brown, of Yale, on "Developments Following From Newton's Work." George E. Roberts, vice-president of the National City Bank of New York and former director of the United States Mint, gave an outline of the work done by Newton while warden of the royal mint during the days when the English government was faced with the proposition of establishing a gold and silver standard of money. He explained the methods Newton employed in establishing a uniform coining system and his mathematical computations to insure a standard of exchange for both gold and silver. To Newton Mr. Roberts gave the credit for the beginning of the present financial stability of the leading countries.

Letters and Books Exhibited

Dr. Lyman C. Newell, professor of chemistry, of Boston University, gave a history of the work done by Newton along the lines of chemistry, showing that most of the research was done mainly for self-information rather than actual discovery, except in relation to his studies on alchemy and his efforts toward the chemical production of precious metals.

Following the adjournment of the meeting Nov. 26, it was announced that the large exhibition of Newton's works, his experiments, letters and books, many of which were brought here for the meeting from English and other museums of the world, would be open to the public until Dec. 17.

President States Attitude Toward Shoals Problem

Stating completely his stand in regard to the settling of the question of Muscle Shoals' disposal, President Coolidge briefly reviewed that situation Dec. 6.

"The last year has seen considerable changes in the problem of Muscle Shoals. Development of other methods show that nitrates can probably be produced at less cost than by the use of hydro-electric power. Extensive investigation made by the Department of War indicates that the nitrate plants on this project are of little value for national defense and can probably be disposed of within two years. The oxidation part of the plants, however, should be retained indefinitely. This leaves this project mostly concerned with power.

"It should, nevertheless, continue to be dedicated to agriculture. It is probable that this desire can be best served by disposing of the plant and applying the revenues received from it to research for methods of more economical production of centralized fertilizer and to demonstrations and other methods of stimulating its use on the farm, but in disposing of the property preference should be given to proposals to use all or part of it for nitrate production and fertilizer manufacture."

Largest Swiss Water Power Plant to Cost 16 Million

By completing the boring of the tunnel 17,000 ft. long, connecting the lakes on the Grimsel Pass, 6,155 ft. above sea level, with Gelmer Lake, the first step has been made in the construction of a hydro-electric project which will be the largest in Switzerland and in Europe. The construction of the development will involve an expenditure of about $16,500,000.

To Consist of Three Plants

The Oberhasli project, which will derive its power from the Grimsel and Gelmer Lakes and from the River Aar, will consist of three electric power plants. A dam 325 ft. high will be built on the Aar, while another, 100 ft. high, will raise the water level so that the two Grimsel Lakes will become one with a capacity of about 300,000,000 cu.ft. These lakes will extend to a length of four miles and stretch as far as the moraine of the Aar glacier.

Project Completed by 1932

From here these lakes, the tunnel, which has just been bored will carry the water to the Gelmar Lake. On this lake a dam 100 ft. high is being constructed. The raising of the level and the extension of the Grimsel Lakes will necessitate the reconstruction of the road leading to the Rhone glacier and Furka Pass.

The water stored in the Gelmar and Grimsel Lakes will be taken to the Handeck plant, at elevation 4,500 ft., where five turbine generators will produce some 150,000 hp. From the Handeck plant the water will descend 1,557 ft. through a tunnel 4½ miles long to the Boden plant at elevation 2,933 ft., where four turbines will produce 88,000 hp. The last stage will have water conduit three miles in length down to Innertkirchen, where four turbines will yield 52,000 horsepower.

It is anticipated that the complete project will be completed by 1932.

Small Concerns Do Bulk of Nation's Business

Despite the conspicuous part played by large-scale enterprise in American economic life, the bulk of business of all kind is still being carried on by relatively small concerns. Even in manufacturing, where large-scale production is the dominant factor as measured by output and number of employees, the moderate sized plant remains the typical unit, according to the National Industrial Conference Board.

While the growth of large-scale business has been most notable in manufacturing, nearly three-fourths of all manufacturing plants in 1923 employed only 20 wage earners or less each, and about two-thirds of all plants produced goods not exceeding $100,000 in value each during the year. The dominant part played by large-scale production, however, can be appraised by the fact that, on basis of 1925 data, it takes only about one-third in number of all manufacturing plants to turn out nine-tenths, in value, of all products, and that this one-third of all plants employs nearly nine-tenths of all wage earners in the industry.

A Place for Large and Small in Competitive Market

While thus a factory employing 1,000 wage earners may be more important than 100 employing 10 workers each, significance is attached by the Conference Board to the fact that the large and the small concerns can do and do exist side by side and in a highly competitive market.

Northwest Interests Seek Project Permits

Four preliminary permits for water power projects in the Northwest were filed with the Federal Power Commission during the first week of the month.

H. L. Vorse, Portland, Ore., applied for a preliminary permit covering a project on the Lake Branch of the West Fork of Hood River. It is planned to install 7,000 hp. at first. The installation is to be increased later to 21,000 horsepower.

Charles H. Lee and Romaine W. Meyers, Oakland, Calif., are seeking a preliminary permit covering a project on the Illinois and Rogue Rivers in Curry and Josephine Counties, Oregon.

J. G. Kelly, of Portland, Ore., has applied for a preliminary permit covering a 15,000-hp. project on Marion Lake in Oregon. The same applicant also has asked for a permit covering a 1,300-hp. project on Loon Lake and Mill Creek.

The City of Eugene, Ore., has applied for a preliminary permit covering a project on the McKenzie River in Lane County, Ore.

Obituary

Julian D'Este, president of the Julian D'Este Company, Boston, died Dec. 2. Many years ago Mr. D'Este purchased the Curtis Regulator Company and continued the manufacture of their steam specialties under the name of the Julian D'Este Company.

Carl Eickemeyer consulting mechanical engineer and patentee of several important inventions in the mechanical field, died at his residence, 64 Church Avenue, Brooklyn, N. Y., Dec. 1. A son of the late Rudolph Eickemeyer of Yonkers, N. Y., known particularly for his inventions and manufacture of machines for hat-making, revolver manufacture and for the Eickemeyer dynamos, Mr. Eickemeyer included among his patents automatic pumps, a third rail, a disappearing gun carriage and an improved steel cross-tie. For a number of years he was his father's assistant, and then established the Eickemeyer, Field Manufacturing Company, which later was merged with the General Electric Company. As a consulting engineer during the latter period of his life he was instrumental in the solution of many mechanical problems throughout the country. He belonged to the American Society of Mechanical Engineers and Society of American Military Engineers.

Personal Mention

Lynwood W. Gray has joined the Georgia Power Company to investigate problems involved in the company's program of electrification.

L. Blumberg, assistant professor of mechanical engineering at the University of Delaware, Newark, has been promoted to the rank of associate professor.

Henry I. Harriman has resigned as president of the New England Power Association, and the executive committee selected Frank D. Comerford, of Boston, as his successor. Mr. Harriman said he wished to devote more time to other interests. He will, however, retain his connection with the association as vice-chairman of the board and executive director.

JAMES D. CUNNINGHAM, president of the Republic Flow Meters Company, Chicago, has been elected to the office of president of the Illinois Manufacturers' Association. Mr. Cunningham is a member of the A.S.M.E.

WILLIAM F. THOMPSON, formerly foreman in the electrical department, has been appointed superintendent of electrical distribution of the Peoples Light Company, Davenport, Iowa. He will succeed Lou J. Roberts, who was recently appointed assistant to C. R. Stahl, general manager of the Panhandle Power & Light Company at Borger, Texas.

WALTER S. BURCH, junior past-president of the Rochester Engineering Society, severed his connection as head of the engineering department of the Rochester Gas & Electric Corporation and joined the staff of the Schiefer Electric Company, Inc., as chief engineer, Nov. 1. Under his jurisdiction is the department in charge of circuit-breaker application for substations and generating plants.

MORGAN WASHBURN, JR., member of the A.S.M.E., has resigned his position as assistant manager of J. A. Tuthill, Los Angeles, and is now in business for himself at 1855 Industrial Street, representing the C. Lee Cook Manufacturing Company, Louisville, Ky., manufacturers of graphitic iron piston rings, metallic rod castings and graphitic iron castings, and the Power Plant Equipment Company, Kansas City, Mo., manufacturers of cooling towers, cooling ponds and nozzles, steam superheaters and steam purifiers.

Society Affairs

A.S.M.E. and WESTERN SOCIETY OF ENGINEERS will hold a joint meeting Dec. 19, 1936 Monadnock Block, Chicago —subject, "Energy from the Atom."

A.S.M.E., BUFFALO, Dec. 13, Hotel Statler, at 8:00 p.m.; "The Present Standing of Various Standards Now Being Developed for Valves and Fittings for High Pressure Steam Service," by F. H. Morhead, chief engineer of the Walworth Company. There will also be slides showing in detail the design of high pressure valves and fittings for application to service requirements.

ROCHESTER ENGINEERING SOCIETY will hold a joint meeting with the A.I.E.E. at the Hotel Sagamore, evening of Dec. 16, with the subject—"Additions and Betterments to the Gas & Electric Corporation's System." The electrical features of the isolated phase switchhouse at Station 3 and new 23,000-hp. wheel and generator at Station 5 will be discussed by E. K. Huntington and L. R. Scott; the hydraulic features will be described by C. A. Woodruff.

Business Notes

THE SOUTHERN MANGANESE STEEL COMPANY, St. Louis, Mo., has announced in connection with the production of heat- and corrosion-resisting alloy produced and sold under the trade name of Fahralloy, the addition of a new 500-lb. electric melting furnace. This is contemplated for a new building, confining the operation exclusively to the production of the smaller and lighter design castings in Fahralloy. This furnace will work as an auxiliary to the 1½-ton electric melting furnace now used in the production of Fahralloy.

Coming Conventions

American Boiler Manufacturers Association, winter meeting, Hotel Cleveland, Cleveland, Feb. 7; A. C. Baker, sec., 801 Rockefeller Bldg.

American Engineering Council, annual meeting will be held in Washington, D. C., Jan. 9-11; L. W. Wallace, executive secretary, 26 Jackson Place, N. W., Washington, D. C.

American Society of Heating & Ventilating Engineers, hold general meeting at Hotel Pennsylvania in New York City, Jan. 23-26; A. V. Hutchinson, sec., 29 W. 39th St., New York.

American Water Works Association. Annual meeting, Hotel Fairmont, San Francisco, June 11-16; W. M. Niesley, 170 Broadway, New York City.

Midwest Power Conference and Exhibition, at Chicago, Feb. 14-17; G. E. Pfisterer, sec., 53 West Jackson Blvd., Chicago.

National District Heating Association, annual meeting in May; D. L. Gaskill, sec. 112 West 4th St., Greenville, Ohio.

The National Marine Engineers' Beneficial Association, 53rd annual convention, will meet at the Lee House, 15th and L Streets, N. W., Washington, D. C., February 13-18. Albert L. Jones, Secretary-Treasurer, 313 Machinists Building, Washington, D. C.

THE HAZARD WIRE ROPE COMPANY, Wilkes-Barre, Pa., acquired Nov. 1 the wire rope division of the Waterbury Company in New York. The Hazard Company had its inception in the iron wire and nail mill operated by Erskine Hazard and Josiah White in the outskirts of Philadelphia in 1810. The Waterbury Company, founded in 1816 for the manufacture of fiber cordage, added a wire rope division in 1899, originating many types of wire rope.

THE DEARBORN CHEMICAL COMPANY, Chicago, has opened new offices, plant and warehouse in Los Angeles at 807-815 Mateo Street, under the management of Alex B. Burns. The plant is equipped with several blending tanks, for the compounding of oils for individual lubrication requirements, together with machinery and equipment necessary for the manufacture and storage of other products manufactured by the company, chief of which are Dearborn scientific water treating preparations and NO-OX-ID rust preventive.

THE PITTSBURGH VALVE, FOUNDRY & CONSTRUCTION COMPANY announces the addition to its sales organization of Robert Whyte, who for many years has been associated with the Pittsburgh Piping & Equipment Company, and the American Foundry & Construction Company.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Nov. 30 1927
Pool 1	New York	$2.35@$2.75
Smokeless	Boston	1.39
Clearfield	Boston	1.60@ 1.85
Somerset	Boston	1.70@ 2.00
Kanawha	Columbus	1.40@ 1.60
Hocking	Columbus	1.50@ 1.75
Pittsburgh	Pittsburgh	1.75@ 1.90
Pittsburgh gas slack	Pittsburgh	1.00@ 1.15
Franklin, Ill.	Chicago	2.25@ 2.50
Central, Ill.	Chicago	2.00@ 2.25
Ind. 4th Vein	Chicago	2.00@ 2.35
West Ky.	Louisville	1.00@ 1.50
S. E. Ky.	Louisville	1.25@ 1.75
Big Seam	Birmingham	1.65@ 2.00
Anthracite (Gross Tons)		
Buckwheat No. 1.	New York	2.75@ 3.25
Buckwheat No. 1.	Philadelphia	3.00@ 3.75
Birdseye	New York	1.50@ 1.60

FUEL OIL

New York—Dec. 7, light oil, tank-car lots, 26 deg. Baumé, 5c. per gal.; 28 deg., 5½c. per gal., f.o.b. Bayonne, N. J.

St. Louis — Nov. 30, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.55 per bbl.; 26@28 deg., $1.60 per bbl.; 28@30 deg., $1.65 per bbl.; 30@32 deg., $1.70 per bbl.; 32@36 deg., gas oil, 4.3c. per gal.; 38@40 deg., 5.3c. per gal.

Pittsburgh—Nov. 28, f.o.b. local refinery, 30@34 deg., fuel oil, 4½c. per gal.; 36@40 deg., 4¾c. per gal.

Philadelphia — Nov. 30, 26@30 deg., $1.60@$1.66 per bbl.; 13@19 deg., $1.47 @$1.53 per bbl.; 22 plus, $1.63@$1.69 per bbl.; 27@30, $2.10@$2.16 per bbl.

Cincinnati—Nov. 29, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.9c. per gal.; 26@30 deg., 5.15c. per gal.; 30@32 deg., 5½c. per gal.

Chicago—Dec. 3, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 80@85c. per bbl.; 26@30 deg., 90c. per bbl.; 30@32 deg., $1.05 per bbl.

Boston—Dec. 5, tank-car lots, f.o.b., 12@14 deg. Baumé, 4.23c. per gal.; 28@32 deg., 5¾c. per gal.

Dallas—Dec. 3, f.o.b. local refinery, 26@30 deg., $1.45 per bbl.

GILBY WIRE COMPANY, for the last five years located at 123 Jackson St., Newark, N. J., expects to move to the new plant on Riverside Avenue, Newark, during December. This plant is located between the Riverside and Woodside Stations on the Erie Railroad, near the Passaic River.

THE COCHRANE CORPORATION announces the appointment of the Cochrane Sales Company, Inc., 50 Church St., New York City, as its representative for the sale of Cochrane equipment, succeeding the late F. E. Idell. The officers of the Cochrane Sales Company, Inc. are F. B. Sage, A. R. Foote and W. W. Montalvo, Jr., who for a long time were associated with Mr. Idell.

Trade Catalogs

INSTRUCTIONS FOR ADDING NICKEL TO CAST IRON — The International Nickel Company. A chart illustrating the approved foundry practice for adding nickel and chromium in the ladle or cupola spout with a handy reference covering the types of castings for which alloy additions are recommended and are being successfully used. Printed on a substantial grade of cardboard.

ALLOY CAST IRON MEETS HIGH-DUTY REQUIREMENTS — The International Nickel Company has issued a practical, non-technical description of the improved physical properties secured by the addition of Grade "F" nickel to gray cast iron, with a tabulation of the physical and mechanical characteristics of the alloy iron as determined by physical laboratory investigations and tests conducted in the field.

SMOOT TURBINE TYPE VALVE—Smoot Engineering Corporation, 136 Liberty St., New York City, has described in the recent Bulletin 39, the company's turbine valve, built for the high-pressure and superheated steam requirements of the modern power station. A gradual opening, high lift, balanced valve, its throat is shaped like a turbine steam nozzle, but with a graduated area, and the point of the highest steam velocity is away from the seating surfaces. The valve and its seat are so designed that the surfaces subject to the high velocity steam flow, change with each position of the valve, and the high velocity flows are kept tangent to the actual closing surfaces.

HYDROGEN ION CONTROL—La Motte Chemical Products Company, Baltimore, has published in simple language and in a handy well ordered bulletin form "The A B C of Hydrogen Ion Control," a discussion of the meaning of hydrogen ion concentration and pH values, by W. A. Taylor, Ph.D., president and general director of the company.

NOTES ON MACHINING ALLOY STEEL —The International Nickel Company, in Bulletin No. 11, of 12 pages gives a presentation of exact data developed from recent exhaustive research clearly demonstrating that under conditions of properly controlled shop practice nickel steels may be more readily machined than carbon or other alloy steels of the same tensile strength. The optimum tool cutting conditions are fully discussed and the relative machinability of alloy and carbon steels is dealt with in detail.

NEW PLANT CONSTRUCTION

Arkansas — Methodist Church in Arkansas, J. Thomas, Exchange Bank Bldg., Little Rock, is having preliminary plans prepared for the construction of a university building. Estimated cost $2,500,000.

Ark., Osecola—Sub-Dist. 1, Drainage Dist. 8, R. E. Lee Wilson, Jr., will soon award contract for the construction of a drainage pumping plant including electrically driven pumping machinery, etc. Morgan Engineering Co., Goodwyn Institute Bldg., Memphis, Tenn.

Calif., Long Beach—City Council is receiving bids for the construction of two pumping stations, etc. for sewerage treatment works. Estimated cost $650,000.

Calif., Oakdale—Union Ice Co., 354 Pine St., San Francisco, is having plans prepared for the construction of a 35 ton ice and cold storage plant at H St. and West Railroad Ave. here. Estimated cost $50,000. Private plans.

Calif., Oakland—Owner, c/o H. Schroeder, 354 Hobart St., Archt is having preliminary plans prepared for a 14 story hotel Estimated cost $500,000.

Calif., Santa Ana—City, E. L. Vegley, Clk., will soon award contract for the construction of a sewage pumping station including pumping equipment, etc. Burns-McDonnell-Smith Engineering Co., Western Pacific Bldg., Los Angeles, is engineer.

Ill., Chicago — Arthrop Building Corp., c/o E. A. Nitsche, 28 East Huron St., Archt., is having plans prepared for the construction of a store building including central refrigeration plant, elevators, etc. at 1104 Argyle St. Estimated cost $1,000,000.

Ill., Chicago—McConnell Warehouse Co., c/o S. Scott Joy, 180 North Michigan Ave., Archt., plans the construction of a 15 story warehouse, etc. at Austin Ave. and Orleans, Illinois and Kingsbury Sts. Estimated cost $3,000,000.

Ill., Chicago—Sanitary Dist. of Chicago, 910 South Michigan Ave., will soon receive bids for the construction of an electric sub-station on Howard St. Estimated cost $350,000. E. J. Kelly, 910 South Michigan Ave., is engineer.

Ill., Dwight — U. S. Veterans Bureau, Room 791 Arlington Bldg., Washington, D. C., will receive bids until Dec. 29 for the installation of a refrigeration plant at U. S. Veterans' Hospital here.

Ky., Covington—Local Syndicate, c/o P. J. Bradshaw, International Life Bldg., St. Louis, Mo., Archt., is having preliminary plans prepared for an 8 story hotel. Estimated cost $1,000,000.

Me., Lewiston — Central Maine Power Co., Water St., Augusta, will build a hydro-electric generating plant at Deer Rips on Androscoggin River. Private plans.

Mass., Dorchester (Boston P. O.)—Transit Dept., 1 Beacon St., Boston, awarded contract for the construction of a heating plant at Fields Corner Station, here to White Construction Co., 11 Beacon St., Boston. Estimated cost $164,744.

Mass., Lynn—Lynn Gas & Electric Co., E. B. Frazer, 90 Exchange St., will receive bids until Dec. 14 for the construction of an exchange tunnel and boiler house on Broad St. Estimated cost to exceed $40,000. Stone & Webster Inc., 24 Federal St., Boston, are architects and engineers.

Mich., Birmingham—A. Kahn, 1000 Marquette Bldg., Detroit, Archt., is receiving bids for an 8 story office building including steam heating system, boilers, elevators, etc. on West Maple St. here, for Wabeek Corp. Estimated cost $1,000,000.

Mich., Detroit—Hudson Motor Car Co., 10617 Knodell Ave., awarded contract for the construction of addition to auto plant including detached power plant, etc. to Martin-Krausmann Co., 955 East Jefferson Ave. Estimated cost $125,000.

Mich., Grosse Ile—H. F. Stanton, 2231 Park Ave., Detroit, Archt., is preparing plans for the construction of a swimming pool including steam heating plant, pumps, etc. here. Estimated cost $30,000. Owner's name withheld.

Mich., Windmill Point (mail Burch Run) —U. S. Treasury Dept., Washington, D. C., is having plans prepared for the construction of a hospital including steam heating and ventilation systems, boilers, elevators, etc. on Jefferson Ave., here. Estimated cost $600,000. J. A. Wetmore, Washington, D. C. Supervising Architect.

Minn., Minneapolis — Chamber of Commerce, J. G. McHugh, Secy., 123 Chamber of Commerce Bldg., is having plans prepared for a 6 or 7 story office building including steam heating system, elevators, etc. at 4th Ave. S. and 3rd St. Estimated cost $600,000. Bertrand & Chamberlin, 616 Northwestern Bank Bldg., are architects.

Mo., Bolivar—City plans an election in January to vote $40,000 bonds for waterworks improvements including pumps, mains, etc.

Mo., St. Louis — J. R. Fleming, 4460 Gibson Ave., has acquired a site and plans the construction of a 12 story apartment at 4615 Lindell St. Estimated cost $1,000,000.

Mo., St. Louis — Syndicate, c/o H. R. Weisels Co. Inc., 730 Chestnut St., is having preliminary plans prepared for a 20 story hotel at Market and 17th to 18th Sts. Estimated cost $5,000,000.

N. J., Elizabeth—Dry Ice Co. of America, 50 East 42nd St., New York, N. Y., plans the construction of a plant for the manufacture of solid carbon-dioxide to replace water ice for refrigeration. Estimated cost including equipment $300,000. C. O. Brown, 331 Madison Ave., New York, N. Y., is consulting engineer.

N. J., Mount Ephriam—Borough Council, c/o G. Fox, plans the construction of two sewage pumping stations, reservoir, etc. for sewerage system. Estimated cost $300,000.

N. Y., Brooklyn—Williamsburg Savings Bank, awarded contract for the construction of a 40 story bank and office building at Hanson and Ashland Pls. to William Kennedy Construction Co., 215 Montague St. Estimated cost $4,000,000.

N. Y., New York—Babies Hospital, c/o Joint Board Columbia University-Presbyterian Hospital, 135 East 55th St., is having plans prepared for an 11 story hospital at Broadway and 165th St. Estimated cost $1,400,000. H. C. Pelton, 415 Lexington Ave. and J. Gamble Rogers, 154 East 46th St., are architects.

N. Y., New York—Bing & Bing, 119 West 40th St., are receiving bids for a 15 story apartment building including steam heating and ventilation systems, boilers, pumps, elevators, etc. at 94th St. and 5th Ave. Estimated cost $1,000,000. E. Roth, 1440 Broadway, is architect.

N. Y., New York—The Brodway Block Corp., c/o W. Melville, 191 Hudson St., is having plans prepared for the construction of a store and dance hall at Broadway and 51st St. Estimated cost $1,100,000. Schultz & Weaver, 17 East 49th St., are architects.

N. Y., New York—Dept. of Public Welfare, Municipal Bldg., will receive bids until Dec. 14 for addition to power house, etc. at Lincoln Hospital, Concord Ave. and East 141st to 142nd Sts.

N. Y., New York—Forty West Seventy Seventh St. Corp., c/o J. M. Felson, 250 West 57th St., Archt., is having plans prepared for a 16 story apartment. Estimated cost $1,500,000. Work will probably be done by separate contracts.

N. Y., New York — Lefcourt & Hass Finance Corp., 1351 Broadway, will build a 42 story office building at 5th Ave. and 43rd St. Estimated cost $11,000,000. Shreve & Lamb, 11 East 44th St., are architects. Work will be done by separate contracts.

N. Y., New York—New York Hospital & Cornell Medical College Assn., E. W. Sheldon, Pres., 45 Wall St., awarded contract for the construction of a 10 story hospital at Ave. A and 69th to 70th Sts. to Marc Eidlitz & Son Inc., 41 East 42nd St. Estimated cost $7,000,000.

N. Y., New York—One Hundred Forty West Eighty First St. Corp., c/o J. M. Felson, 250 West 57th St., Archt., is having plans prepared for a 12 story apartment at Lexington Ave. and 81st St. Estimated cost $1,000,000. Work will probably be done by separate contracts.

N. Y., New York—Paterno Bros., 601 West 115th St., will build a 14 story apartment at Sutton Pl. and 58th St. Estimated cost $850,000. Rosario Candela, 578 Madison Ave., is architect. Work will be done by separate contracts. Owners are general contractors.

O., Lakewood — P. F. Price, 12719 St. Clair Ave., Cleveland, is having plans prepared for a 12 story apartment building including steam heating and refrigeration systems, etc. on Edgewater Dr., here. Estimated cost $750,000. Allen-Osborn Co., Rose Bldg., Cleveland, is architect and engineer.

O., Toledo — Toledo Hospital, awarded contract for the construction of a hospital, nurses' home, power house, etc. to A. Bentley & Sons, 201 Belmont St.

Okla., Sand Springs—Sand Springs Home Inc., is having preliminary plans prepared for extensions and improvements to power, light and water plant. Estimated cost $250,000.

Okla., Stillwater—Bd. of Affairs, Capitol, Oklahoma City, Okla., awarded contract for the construction of a dairy including refrigeration plant, to Bailey & Burns, Norman. Estimated cost $150,000.

Okla., Tecumseh—City plans an election to vote $25,000 for waterworks improvements including pumping equipment, mains, etc. M. M. Henderson, Mayor.

Okla., Vinita—City is having preliminary plans prepared for waterworks improvements including filter plant, pumping equipment, etc. Estimated cost $30,000. Engineer not selected.

Pa., Pittsburgh — Consolidated Ice Co., 13th and Pike Sts., is having plans prepared for addition to ice plant to increase the capacity from 100 to 200 tons daily. Estimated cost $100,000. C. C. Coneby, 6611 Euclid Ave., Cleveland, O., is architect and engineer.

Tex., McAllen—Central Power & Light Co., will soon receive bids for a 50 ton ice plant. Estimated cost $100,000.

Ont., Ottawa—Gauoni Insulated Walls Lt., Jackson Bldg., Bank St., will build forty dwellings including central heating plant, etc. Estimated cost $100,000. H. Gauvin, 1008 Bronson Ave., is engineer.

Ont., Toronto—Holt-Gundy & Co., 140 James St., Montreal, Que., is having plans prepared for a 28 story office building including steam heating system, elevators, etc. at King and Bay Sts., here. Estimated cost $2,250,000. Chapman & Oxley, Northern Ontario Bldg., Toronto, are architects.

Equipment Wanted

Boilers—City Water Board, W. D. Masterson, Mgr., San Antonio, Tex., will receive bids until Dec. 21, for two 300 hp. boilers, to cost $40,000.

Boilers, Superheaters, Coal Feeding and Coal Handling Apparatus, Etc.—Dept. of Public Works, Bureau of Water, E. G. Lang, Dir., Philadelphia, Pa., will receive bids until Dec. 15 for boilers, superheaters, coal feeding and coal handling apparatus, etc. for Ross pumping station.

Conveyors—City of Cleveland, O., W. R. Hopkins, Mgr., plans to purchase conveyors for proposed garbage reduction plant. Estimated cost $900,000.

Generator, Condenser, Etc.—City of Alexandria, Minn., plans to purchase a 750 kw. turbine generator, condenser, etc. for proposed addition to power plant, estimated to cost $50,000.

Generators, Circuits, Transformers — Medellin, Republic of Columbia, will receive bids until Dec. 31 for electric generators, electric circuits, and transformers with necessary equipment for electric power house transmission lines, etc.

Ice Plant — McConnell & McLean, Livingston, Ala., wants prices and catalogs on a 50 ton ice plant.

Lightning Arresters, Coke Coils, Barriers, Oil and Knife Switches, Control and Protective Instruments, Etc.—New York Central R.R., Room 344, 466 Lexington Ave., New York, N. Y., C. S. White, Purch. Agt. will receive bids until Dec. 16 for lightning arresters, choke coils, barriers, oil and knife switches, control and protective instruments, etc. for sub-stations to be covered by Serial Contract No. 24-1927.

Motor Generator Sets and Switchboard Equipment—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until Dec. 14 for motor generator sets and switchboard equipment at Navy Yard, Brooklyn, N. Y.

Pump, Etc.—Barco Investment Co., 602 Builders Exchange Bldg., Los Angeles, Calif., is receiving bids for pump, etc. for proposed waterworks improvements, at Artesia, Calif.

Pump, Etc.—City of Royal Oak, Mich., plans to purchase an electrically operated centrifugal booster pump for booster pumping station in connection with Detroit water supply, estimated to cost $20,000.

Pump and Motor—City of Minneapolis, Minn., will receive bids until Dec. 22, for a 20,000,000 g.p.m. pump and motor for waterworks department.

Pumping Equipment — M. Beatty, Clk., Los Angeles, Calif., will receive bids until Jan. 3 for pumping equipment, etc. for proposed waterworks improvements for Waterworks Dist. 10 in Willowbrook Tract near Compton, Calif.

Pumping Unit—City of Boerne, Tex., will receive bids until Dec. 23 for a pumping unit, etc. for proposed waterworks and distribution system, estimated to cost $60,000.

Pumping Units, Pumps, Etc. — K. R. Holmes, City Secy., Abilene, Tex., will receive bids until Dec. 16 for two 5 m.g.p.d. duplicate pumping units against 150 ft. static or friction head, also electric or oil engine driven pumps, etc. for proposed waterworks improvements.

Pumps, Blowers, Etc.—Dry Ice Co. of America, 50 East 42nd St., New York, N. Y., plans to purchase pumps and blowers, etc. for proposed plant at Elizabeth, N. J.

Pumps, Etc.—Sewerage & Water Board, G. G. Earl, Gen. Supt., New Orleans, La., will receive bids until Jan. 23, for pumps, etc. for river pumping station.

Pumps and Motors—City of Marysville, Calif., is receiving bids for furnishing and installing pumps and motors, etc. for sewage treatment works.

Pumps, Motors, Engine, Switchboard, Etc.—City of Bradenton, Fla., R. K. Van Camp, Comr. of Public Works, will receive bids until Dec. 30 for three 1,750 g.p.m. pumps direct connected to multi cylinder gasoline engine and 750 g.p.m. centrifugal pumps, direct connected to electric motors, one 100 kw. multi-cylinder vertical gasoline or Diesel driven a.c. generating unit, switchboard, etc. for pumping plant.

Pumps, Oil Purifier, Transformers, Etc.—Bureau of Yards & Docks, Navy Dept., Washington, D. C., plans to purchase motor driven horizontal and vertical centrifugal pumps, one motor driven rotary pump, one centrifugal oil purifier, transformers, etc. for proposed Diesel oil purification plant at Naval Operating Base, Pearl Harbor, T. H.

Switchboard Panels, Branch Circuit Panels, Etc. — Bd. of Trustees, Warren State Hospital, H. W. Mitchell, Supt., Warren, Pa., will receive bids until Dec. 22 for furnishing and installing switchboard panels, branch circuit panels, etc.

Transformers, Switches, Etc. — Hydro Electric Power Commission of Ontario, 110 University Ave., Toronto, Ont., plans to purchase transformers, switches, etc. for proposed electric sub-station at Oshawa, Ont. Estimated cost $50,000.

POWER *Information Bureau*

Your machinery, equipment, and materials requirements will be noted *free of charge* in the New Plant Construction section of POWER.

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PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

FURTHER decline occurred in mica-cap fuse plugs during the month; current price is 15c. per standard package, below the Nov. 8 level; the decrease from October to November was 10c. Brass-shell sockets are off 1@2c., compared with last month's quotations. Price recessions also developed in portland cement and genuine, highest grade babbitt metal. Linseed oil tends upward at eastern and western points; maximum on white, wiping cloths is also higher.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket		(net) 68c. per ft.
Common, 2½-in., cotton-rubber lined	80c. per ft. list, less	50%

Air—Best grade

¾-in., per ft.	3-ply	$0.34	4 ply	$0.42

Steam—Discounts from List

First grade	40%	Second grade	40–5%	Third grade 50%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade	50%	Second grade	50–10%

LEATHER BELTING—List price, 24c., per lin.ft. per inch of width, for single ply, at New York warehouses:

Grade	Discount from list
Medium	35%
Heavy	30%

RAWHIDE LACING—For cut, best grade, 50%; 2nd grade, 60%. For laces in sides, best, 41c. per sq.ft.; 2nd, 37c. Semi-tanned: cut, 50%; sides, 41c. per sq.ft.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in.	$0.95
Asbestos for high-pressure steam, ⅛ in.	1.75
Duck and rubber for piston packing	.95
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.30
Rubber sheet	.50
Rubber sheet, wire insertion	.80
Rubber sheet, duck insertion	.60
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts, New York warehouses, are as follows:

85% magnesia high pressure		50%
Asbestos, air cell, for low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York, $2.25@2.35 per bbl. without bags, in carload lots, delivered by truck to site of job. Bag charge, 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.34 per 100 lb.

COTTON WASTE—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	10.00@13.50	16.00	15.00@20.00
Colored	9.00@13.00	12.00	12.00@17.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed, white wipers, as follows:

Chicago	$0.15
New York	.15½@.17½
Cleveland *per thousand*	36.00

LINSEED OIL—These prices are per 7½-lb. gallon:

	New York	Cleveland	Chicago
Raw in barrels (5 bbl. lots)	$0.79½	$0.89	$0.83

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Current	1 Yr. Ago	Current	1 Yr. Ago
Red	$13.75	$15.25	$15.25	$16.75
White	13.75	15.25	13.75	15.25

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

Tank rivets, small, including ⅝-in. dia., list (Apr. 1, 1927) less 50-10% in full keg lots, for immdeiate delivery from warehouse stocks in New York and vicinity.

Structural rivets, per 100 lb.:
New York $5.00* Chicago $3.60 Pittsburgh mill $2.75@$3.00

Cone-head boiler rivets, per 100 lb.:
New York $5.00* Chicago $3.60 Pittsburgh mill $3.00

*Price is for full keg lots; broken keg lots, $6.50 net.

REFRACTORIES—Prices in car-load lots, f.o.b. plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome cement, 40@50% Cr_2O_3, in bulk	per net ton	22@25
Chrome cement, 40@50% Cr_2O_3, in sacks	per net ton	26@29
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, Soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa.	per M	43.00
Clay brick, 1st quality, 9 in. shapes, Pennsylvania	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	35@38
Chrome ore crude, 40@50%	per net ton	18.00@22.50

BABBITT METAL—Delivered, New York, cents per lb.:

Genuine, highest grade	76.00
Commercial genuine, intermediate grade	61.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	12.50

COLD DRAWN STEEL—Warehouse prices per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Shafting and screw stock, round and hexagon	$4.00	$3.65	$3.60
Flats and squares	4.50	4.15	4.10

BOILER FITTINGS—F. o. b. New York or Jersey City, discounts from list:

	Current
Copper ferrules	70%
Boiler flanges	65-5%
Boiler stay bolts	60%
Boiler patch bolts	20%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

	Steel			Iron	
Inches	Black	Galv.	Inches	Black	Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 and 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

BOILER TUBES—Following are net prices per 100 ft. at New York warehouse on tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$17.07
1¼	.....	.....	19.20
1½	.....	$38.00	17.92
1¾	.....	28.50	20.48
2	$17.33	25.00	20.24
2¼	19.84	28.25	23.00
2½	21.60	34.00	26.03
3	25.50	42.50	27.04
3¼	30.25	49.50	30.67
3½	31.50	52.75	33.33
4	38.03	67.00	40.11

Tubes 2½ in. diameter, or smaller, over 18 ft. long, 10 per cent extra.

These prices are net per 100 ft. based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths.

In addition to the above, standard cutting charges are as follows:

2 in. and smaller.. 5c. per cut. 3 in..... 9c. per cut.
2½ and 2½ in..... 6c. per cut. 3½ to 4 in.... 10c. per cut.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent. 10 days.

B. & S. Size	Two Cond. M Ft.	Three Cond. M Ft.	Two Cond. Lead M Ft.	Three Cond. Lead M Ft.
No. 14 solid	$30.00 (net)	$46.00 (net)	$180.00	$220.00
No. 12 solid	136.00	180.00	225.00	275.00
No. 10 solid	185.00	235.00	275.00	325.00
No. 8 stranded	305.00	375.00	420.00	500.00
No. 6 stranded	440.00	530.00	615.00	.....

From the above lists discounts are:

		Lead Covered
Less than coil lots	50%	20%
Coils to 1,000 ft	60%	30%
1,000 to 5,000 ft	65%	35%
5,000 ft. and over	67%	38%

CONDUIT—Price per 1,000 ft.; **ELBOWS AND COUPLINGS**, per 100 pieces, f.o.b. New York, with 10-day discount of 5 per cent.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
¼	$56.50	$61.34	$7.76	$8.83	$4.52	$4.92
½	72.07	78.63	10.21	11.63	6.46	7.03
1	103.31	113.00	15.10	17.21	8.39	9.13
1¼	139.77	152.88	20.51	23.07	11.78	12.75
1½	167.12	182.79	27.34	30.76	14.56	15.75
2	224.85	245.94	50.13	56.40	19.41	21.01
2½	355.50	388.85	82.03	92.28	27.73	30.01
3	464.88	508.50	218.74	246.10	41.59	45.01
3½	585.30	637.74	483.04	543.46	55.46	60.02
4	714.17	776.30	558.23	628.06	69.32	75.02

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less than $10 list	$10 list to $100	$100 list and over
Standard package	10%	20%	28%
Less than standard package	5%	10%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy		$17.75
No. 16 cotton reinforced heavy		22.00
No. 18 cotton reinforced light		14.50
No. 16 cotton reinforced light		18.35
No. 18 cotton Canvasite cord		14.75
No. 16 cotton Canvasite cord		17.20
No. 16 super service cord or similar (2 wire) in 1,000 ft	$72.00	*80.00
No. 14 super service cord or similar (2 wire) in 1,000 ft	110.00	*122.00

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.15	3-amp. to 30-amp.	100	$0.30
35-amp. to 60-amp.	100	.30	35-amp. to 60-amp.	100	.60
61-amp. to 100 amp.	50	.90	65-amp. to 100-amp.	50	1.50
101-amp. to 200-amp.	25	2.00	110-amp. to 200-amp.	25	2.50
201-amp. to 400-amp.	25	3.60	225-amp. to 400-amp.	25	5.50
401-amp. to 600-amp.	10	5.50	450-amp. to 600-amp.	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 64%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.	$0.50	$1.10	100	10
35 to 60-amp.	1.00	1.25	100	10
65 to 100-amp.	2.00	3.00	50	5
110 to 200-amp.	4.00	5.00	25	5
225 to 400-amp.	7.50	11.00	25	1
450 to 600-amp.	11.00	16.00	10	1
REFILLS—				
1 to 30-amp.	$0.03 ea.	$0.05	100	100
35 to 60-amp.	.05 ea.	.06	100	100
65 to 100-amp.	.10 ea.	.10	50	50
110 to 200-amp.	.15 ea.	.15	25	50
225 to 400-amp.	.30 ea.	.30	25	25
450 to 600-amp.	.60 ea.	.60	10	10

Discount Without Contract—Fuses:

Broken carton	5%
Unbroken carton but less than standard package	22%
Standard package	40%

Discount Without Contract—Renewals:

Less than standard package	Net list
Standard package	40%

Discount With Contract—Fuses:

Broken cartons	10%
Unbroken cartons but less than standard package	26%
Standard package	42%

Discount With Contract—Renewals:

Less than standard package	Net list
Standard package	42%

FUSE PLUGS, MICA CAP—

0-30 ampere, standard package (500)	$2.50
0-30 ampere, less than standard package	2.80

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard A type bulbs:

100—130 Volt Watts	Type	Price Each	200—260 Volt Watts	Type	Price Each
15	A 17	$0.23		Special	
	General		25	A 19	$0.28
25	A 19	.23	50	A 21	.28
40	A 21	.23	100	A 23	.50
50	A 21	.25			
60	A 21	.25			
100	A 23	.40			

Standard pkg. quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug	$0.18
Composition, 2-piece, attachment plug	.27
Swivel attachment plug	.12
Small size, 2-piece plug, composition	.07

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f. o. b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14	$6.00	$9.30	$10.90	$17.50
12	9.95	12.50	14.50	24.00
10	13.20	16.25	18.30	31.00
8	19.10	22.50	24.00	43.00
6	.....	.....	33.75	.....
4	.....	.....	47.50	.....
2	.....	.....	66.75	.....
1	.....	.....	92.00	.....
0	.....	.....	113.00	.....
00	.....	.....	134.50	.....
000	.....	.....	161.00	.....
0000	.....	.....	191.50	.....

SOCKETS, BRASS SHELL—Price each, net:

	½ In. or Pendant Cap Key	½ In. or Pendant Cap Keyless	½ In. or Pendant Cap Pull	¾ In. Cap Key	¾ In. Cap Keyless	¾ In. Cap Pull
Standard package	$0.11	$0.11	$0.18	$0.16½	$0.15	$0.22
Unbroken carton	.14	.13	.20	.18	.16	.23
Broken carton	.16	.15	.22	.20	.18	.25

WIRING SUPPLIES—

Friction tape, ¾ in., less than 100 lb., 31c. per lb.	100 lb. lots	29c. per lb
Rubber tape, ¾ in., less than 100 lb., 33c. per lb.	100 lb. lots	31c per lb
Wire solder, less than 100 lb., 33c. per lb.	100 lb. lots	31c. per lb
Soldering paste, 2 oz. cans		$1.00 doz

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c. or a.c., N.E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:

Less than $25.00 list value	30%
$25.00 to $50.00 list value	30-5%
$50.00 list value or over	35%